MONITORING HYDROLOGY, AQUATIC VEGETATION AND FAUNA IN THE SOUTHERN EVERGLADES: 2012-13 ANNUAL REPORT

Jerome J. Lorenz, Peter E. Frezza, Michelle R. Robinson and Michael Kline

Audubon Florida
Everglades Science Center
115 Indian Mound Trail
Tavernier FL, 33070

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Executive Summary

The two main sources of freshwater flow into Florida Bay are Taylor Slough sheetflow and discharge through the C-111 canal. On an annual basis, a greater proportion of the freshwater flow delivered to Florida Bay and, consequently, our study sites is from the C-111 canal. The C-111 Spreader Canal Western Phase (C-111SCWP) should mitigate the imbalance in water delivery to Florida Bay by enhancing connectivity of water flows throughout the system. If the project is successful, it will achieve its primary purpose of adding a regional effect to a traditionally locally driven system. With the completion of the C-111SCWP structures, we expect the subject year (2012-13) to function as a baseline to compare system changes in the future as a locally driven system transitions to a more regional one.

Rainfall

Although total quantity of rainfall across southern Florida is critical to understanding hydropatterns in the southern Everglades, the timing of rainfall is as important when making comparisons between years. Non-linear Multidimensional Scaling (NMDS) was performed on mean monthly rainfall for each of the 50 locations (i.e., one datum per month per location) from the regional watershed in an effort to analyze intra-annual rainfall patterns from the 1993-94HY through 2012-13HY. Based on the results of NMDS, 2008-09 was identified as the year most similar in rainfall patterns to the subject year. We can therefore conclude that the Everglades system had approximately the same rainfall-driven hydropatterns in 2012-13 and 2008-09.

Freshwater Flow

A comparison of annual flow volumes in Taylor Slough and through the C-111 canal indicated that under years of similar flow at Taylor Slough Bridge (TSB), there was comparatively much less discharge out of the C-111 canal during 2012-13. The ratio of flow between C-111 and Taylor Slough (1.3:1) was the lowest during 2012-13 than in any other year over this period of record and exactly half that of the long term mean ratio of 2.6:1. In comparison, during 2008-09, the ratio of flow was 2.8:1, more than double that of 2012-13. Flow at Taylor Slough Bridge during 2012-13 was quite substantial, having the third greatest total annual flow out of the past 20 years. Total annual flow at Taylor Slough Bridge was 95,400 acre-ft during 2012-13. This was 32,000 acre-ft more flow than average in relation to the previous 19 year period. In comparison, flow at Taylor Slough Bridge during 2008-09 was average, representing the median value over this period of record. There was a 49% increase in total annual flow through Taylor Slough in 2012-13 compared to 2008-09. Wet season flow at Taylor Slough Bridge during 2012-13 was the highest out of this 20 year period. In comparison, wet season flow during 2008-09 was slightly below what is typically observed. Discharge from the C-111 indicated that in comparison to 2008-09, discharge during 2012-13 was greatly minimized; 54,000 less acre-ft of water was discharged out of the C-111 canal during 2012-13. Wet season discharge during 2008-09 was the second highest out of the observation period, having more volume than the entire annual discharge during 2012-13. A reduction in flow through the C-111 canal is a desirable response and also an indication that the C-111SCWP is functioning as it was planned. A comparison of wet season flow volumes at the S-177 structure to the upstream S-331 structure since 1984 indicates that by far, 2013 experienced the lowest flows through S-177, relative to S-331.

The new S-199 and S-200 pump structures along the C-111 canal became operational at the beginning of the wet season, 2012. Based on these examinations of flow during 2012-13 in comparison to 2008-09 and the previous 20 year record, it appears that the C-111SCWP project in its initial year of operation has already begun to achieve the desirable effects of minimizing flows through the C-111 canal while increasing flow at Taylor Slough Bridge. Due to the similarities in spatial and temporal rain patterns between the subject and comparison year, we conclude that the changes in flow volumes experienced during 2012-13 occurred as a result of the hydrologic modifications made by operation of the C-111SCWP project and were not a function of increased rainfall throughout the region. While this preliminary assessment of the C-111SCWP has shown positive initial results, it is most likely too early to make any final assessments on capabilities of the project to achieve long term goals.

Water Level and Salinity

As expected in response to increased Taylor Slough flow and minimized C-111 discharge, the downstream mangrove transition zone experienced significantly higher mean relative water levels and lower salinities in 2012-13 than in 2008-09. The mean water levels within all three watersheds were significantly different between the subject and comparison years with higher water levels in 2012-13 for all three watersheds combined by an average of 6.9 cm. Overall, water levels in 2012-13 were higher than in 2008-09 and were rarely if at all exceeded during the 20 year period. Both annual and wet season water levels in 2012-13 were the highest recorded across the 20 year period of record for all three watersheds with the exception of SBB (the project control site) in which the wet season water level was the second highest recorded. Furthermore, water levels in the wet season of 2012-13 exceeded those in 2008-09 in the TS and C-111 watersheds by an average of 5.6 cm while water levels in the SBB watershed were greater in 2008-09 by 1.6 cm.

Salinities were significantly lower in 2012-13 for all three watersheds by an average of 9.6 psu. Salinities were lower in 2012-13 by 12.7 psu in TS, 6.7 psu in C-111, and 9.5 psu in SBB. Annual mean salinity within the TS watershed during 2012-13 was the second lowest out of the past 20 years. In comparison, annual salinities in the C-111 and SBB watersheds were an average of 11.0 psu greater, combined, than in TS. Annual mean salinities in 2008-09, overall, were the second highest recorded for all three watersheds out of the past 20 years. Despite 2008-09 having high salinities of a magnitude rarely seen within the 20 year period of record, salinities during 2012-13 were some of the lowest out of the period within the TS watershed. The high salinities in 2008-09 were likely the result of antecedent conditions which were not taken into account in our analyses. The percent difference in salinity between 2012-13 and 2008-09 was highest in Taylor Slough and lowest in SBB indicating that the control sites (SBB) were not as influenced by upstream flow as the impacted sites (Taylor Slough). Overall, salinity levels in the TS watershed during 2012-13 were very low in comparison to the past 20 years.

The early stages of achieving the short-term goal of restoring a more natural flow regime from upstream to produce increased freshwater conditions more representative of the regional rainfall pattern in the mangrove transition zone is evident in the higher water levels and lower salinities of 2012-13 as compared to 2008-09.

Submerged Aquatic Vegetation (SAV)

The lower salinities observed in 2012-13 as compared to 2008-09 were expected to directly impact the biota at the lower tropic levels by creating conditions necessary for greater productivity and availability of SAV in the mangrove transition zone. Total SAV % coverage and *Ruppia maritima* % coverage were analyzed within the three watersheds to determine the downstream effects on the SAV community. Total SAV % coverage was higher in 2012-13 by an average of 35.4%. For all sites within the three watersheds combined, total SAV % coverage was higher in 2012-13 by an average of 32.3 %. *Ruppia* % coverage was higher in 2012-13 for all sites within the three watersheds combined by 9.1%. The expected response of SAV during 2012-13 in the context of the goals of the C-111SCWP, was an increase in the coverage of brackish and freshwater submerged grass and algae species in the southern mangrove transition zone with decreasing salinities. Total SAV % coverage was higher for all three watersheds in 2012-13: 36.7% in TS, 35.9% in C-111, and 26.5% in SBB.

Based upon responses in total and *Ruppia* % coverage, goals of the C-111SCWP are possibly beginning to be met. Greater SAV coverage in 2012-13 as compared to 2008-09 may be evidence that lower salinities within the southern mangrove transition zone have resulted in a more robust SAV community. The magnitude in the difference in coverage between the subject and comparison year decreased as the SAV community possibly began to respond to hydrologic changes resulting from the C-111SCWP. Although higher SAV cover was observed in 2012-13, it should be noted that antecedent SAV coverage was comparatively higher at the end of 2011-12 than in 2007-08.

Emergent Aquatic Vegetation (EAV)

The three sites used to quantify emergent vegetation represent two of the three watersheds under consideration in this report; TR1 located in TS and JB1 and HC1 located in C-111. The emergent vegetation community coverage and canopy height has been shown to increase with increasing water depth (Lentz and Dunson, 1998; Busch, et al. 2004). In addition, the ratio of shoots to stems is a very good indicator of the response of a plant to changes in physical conditions. An expected response of the emergent vegetation community during 2012-13 in the context of the goals of the C-111SCWP was an increase in the parameters of the number of stems (m^2), the ratio of shoots to stems, and the canopy height in the southern mangrove transition zone with increased hydro-period.

The number of stems (m^2) was higher in 2012-13 by an average of 80.3 stems (m^2). The number of stems (m^2) was significantly higher ($p<0.01$) in 2012-13 by 102.9 stems (m^2) at TR1 and 111.5 stems (m^2) at JB1. Although the difference was not significantly different at HC1, the percent increase from 2008-09 to 2012-13 was the greatest at HC1 and at least twice as great as the percent increase at both TR1 and JB1. The average shoot to stem ratio, 1:3.3, in 2012-13 was greater than the average ratio in 2008-09, 1:1.2, by 2.1 stems per shoot and the canopy height was higher in 2012-13 by an average of 14.0 cm. Canopy height was significantly higher in 2012-13 by 23.0 cm at TR1 and by 13.1 cm at JB1. The number of stems, the ratio of shoots to stems, and the canopy height were higher at all three sites in 2012-13 concurrent with greater hydro-periods in the TS, C-111, and SBB watersheds. The response of the emergent vegetation community highlights increased growth correlated with increased water levels in 2012-13, signaling possible positive biologic responses from operation of the C-111SCWP. Greater growth and abundance of the emergent vegetation community within the southern mangrove transition zone may over time provide more habitat for the prey base fish community and subsequent increase in availability of prey for tactile feeding birds during the dry season.

Fish Community

Based on the findings in hydrology and plant assessment we hypothesized that there would be a shift in the community structure of prey base fish towards a population with more freshwater species. In addition, it would be expected that fish density and biomass levels would increase in 2012-13 as it has been shown that both density and biomass will progressively increase as salinity levels decrease. Results of analyses on prey base fish indicated that 2012-13 did not experience the expected higher density and biomass values; however, there was a noted shift in the community structure.

There were far less fish collected in 2012-13, however, all three watersheds showed more species diversity within the fish community during 2012-13 in comparison to 2008-09. A total of 3721 fish were collected in the Taylor Slough watershed consisting of 23 species in 2012-13 which was 1048 less fish, but 4 more species than what was collected in 2008-09. The percentage of freshwater species was much greater in 2012-13. In 2008-09 only 0.2% of the annual catch consisted of freshwater species, whereas in 2012-13 this number increased to 6.0%. The fish stratified biomass was lower in 2012-13 with a mean of 1.15 g/m^2 compared to the mean stratified biomass in 2008-09, 2.41 g/m. There was not a statistically significant difference between the two years in fish density but 2012-13 had a mean of 3.2 $fish/m^2$ (SE=0.27) and a mean of 4.18 $fish/m^2$ (SE=0.28) was found in 2008-09.

Although the density, biomass, available density and available biomass did not show support for this project's success in 2012-13, it could show support in future years with lower water levels and as the fish populations further adapt to a freshwater community which could take up to 3 years to reach the pre-drainage conditions of the Everglades (Lorenz and Serafy, 2006).

Spoonbill Nesting Success and Prey Availability

Spoonbill nests were monitored in northeastern Florida Bay in 2008-09 (63 total nests) and in 2012-13 (188 total nests). The average number of chicks that survived until 21d post-hatch (when the birds leave the nest and can no longer be monitored) was 1.77 chicks/nest attempt (c/n) in 2008-09 and 1.29 c/n in 2012-13. The nestling period (period from when the first egg hatches to the last nest has chicks at 21d post-hatch) was the months of December through February in 2008-09 and late February through April in 2012-13.

In December 2008, the highest available fish density recorded for all sites for that year was at CS and relatively high density was recorded from both TR and HC. In January 2009, there was relatively high available density at SB, MB, and CS and extremely high densities at JB. In February 2009, available density was very high at CS and moderately high at MB and WJ. The high degree of available fish across a broad spatial scale, especially during the earliest stages of chick development when their energetic demand is extremely high, likely explains the high degree of nesting success in the 2008-09 nesting season.

In March 2013, fish availability was low at all sites, however, modest availability occurred at TR, EC, and JB. Perhaps the centrality of these 3 sites made foraging easier for nesting spoonbills so the relatively low concentrations of fish may have been offset by flight time to the foraging grounds, i.e., shorter travel may result in longer foraging time. In April 2013, highest densities for the year were recorded at JB, SB and HC thereby providing adequate foraging resources later in the chick's development.

Between 1982-83 and 2004-05, spoonbills averaged 1 c/n or more in only 7 of the 20 years that nests were monitored. The success rate of 1.29 c/n in 2012-13 marks the sixth time in the last seven years that spoonbills produced >1c/n. This change coincides with increased communication between the operations team at the South Florida Water Management District and Audubon scientists. This year also marks the second consecutive year with an increase in nest number over the previous suggesting that the chicks produced over the last seven years are entering the breeding population.

Lorenz (2013b) demonstrated that this happens when water levels are above 13 cm relative depth on the flats habitat. During the nestling period of 2008-09, water levels were below the 13 cm mark at all of the sites within the Taylor Slough and C-111 watersheds but not in the Southern Biscayne Bay watershed thereby providing concentrations of fish to nesting spoonbills. During the nesting period of 2012-13, water levels fluctuated around 13 cm at all sites in the Taylor Slough and C-111 watersheds. The temporal fluctuations at the Taylor Slough and C-111 sites must have been such that they were spatially out of synch with each other such that there were adequate foraging conditions at one location or another throughout the breeding season such that spoonbills were able to find adequate food resources for them to successfully raise their chicks.

INTRODUCTION

The National Audubon Society has been monitoring hydrologic conditions and resident prey base fishes in the coastal mangrove zone of northeastern Florida Bay since 1990. The emphasis of this research is placed on hydrologic conditions within these ecotonal wetlands, and how these conditions affect submerged aquatic vegetation (SAV) and fish populations in the watershed. These primary and secondary producers serve a vital purpose in Florida Bay, making up the food base for many higher trophic level predators such as game fishes, crocodilians, wading birds, and piscivorous birds of prey. Within this project initiative, nine independent research sites were monitored for hydrology, SAV, and prey base fish (Figure 1). Data collection was initiated at four of these sites in the early to mid 1990's. These long term sites as indicated in Figure 1 are Taylor River (TR), Joe Bay (JB), Highway Creek (HC) and Barnes Sound (BS). Monitoring of SAV and emergent aquatic vegetation (EAV) within these wetlands was added to augment hydrologic and fish monitoring in 1996 at the long term sites. To complement existing research initiatives, additional research sites were added in subsequent years, at which hydrology, SAV, and prey base fish are monitored. These sites and year of establishment are: Card Sound (CS) and Manatee Bay (MB), 2002; Sunday Bay (SB), West Joe Bay (WJ), East Creek (EC), 2005 (Figure 1).

Hydroperiod and salinity in the mangrove wetlands of northeastern Florida Bay are affected by rainfall, local weather phenomena, and water management. Water levels and salinity in the mangrove wetlands of Florida Bay go through a stereotypic annual cycle, (Holmquist et al., 1989, Marmar 1954) with water levels climbing above the annual mean in June, remaining above average through November, dropping below the annual mean in December, and remaining below average through May. This cycle is caused by the wet season/dry season climate cycle that occurs in southern Florida. Typically, it is the wet season conditions that determine water levels and salinity in the dry season. Given the natural break in hydrology in June, the annual hydrologic cycle for the mangrove wetlands is considered to begin in June with increases in water level, and end in May when water levels are still below average (Holmquist et al., 1989). Therefore, this report analyzes rainfall, hydrology, submerged aquatic vegetation, emergent aquatic vegetation and the demersal fish community dynamics within the coastal mangrove wetlands of northeastern Florida Bay and southern Biscayne Bay for the period June 1, 2012 - May 31, 2013 or the hydrologic year 13 (HY13).

Historically, the amount of fresh water these sites received from the Everglades presumably decreased from west (TR) to east (HC) based on site proximity to Taylor Slough. However, the natural sheet flow pattern of the Everglades has been largely disrupted by water management practices. Since about 1982, the amount of fresh water received at the sites has primarily been determined by water management operations (Johnson and Fennema 1989). There are two main sources of freshwater flow into Florida Bay, Taylor Slough sheetflow and C-111 discharge (Figure 2). Figure 3 indicates that currently the majority of water delivered to the Bay is through the C-111. The C-111 canal draws water from the upper reaches of Taylor Slough and redirects it to the far eastern corner of Florida Bay rather than to central Florida Bay (Figure 2; Lorenz 2000).

This report is designed to evaluate the affects of the C-111 Spreader Canal Western Phase (C-111SCWP) on the coastal environments of Florida Bay. The infrastructure for this project, including the new S-199 and S-200 pump structures were completed in January 2012 and became operational at the beginning of the wet season of 2012. The objective of the project is to reduce the amount of seepage from Taylor Slough into the C-111 canal by creating a hydrologic ridge on the eastern boundary of Everglades National Park with the intent to create more natural hydropatterns and salinity in northeastern Florida Bay. The goal of this project must not be to merely increase freshwater flows to Taylor Slough but to achieve interim restoration and prevent the southern Everglades and northeastern Florida Bay from experiencing further decline. Sufficient flows to Taylor Slough will create a spillover effect, rehydrating nearby wetlands and imbedded lakes that have become more saline as a result of decades of diminished freshwater flows. The success of the C-111SCWP project will be determined by whether the project features are operated so that the ecosystem responds by exhibiting the following short and mid-term ecosystem goals. After additional restoration projects come online, i.e., Tamiami Trail bridging and Central Everglades projects, thus creating the opportunity for increased deliveries of fresh water, longer term goals may be achieved.

Short-term Ecosystem Goals:

- Increased freshwater conditions across the southern mangrove transition zone
- Increase in coverage by brackish and freshwater submerged grass and algae species in the southern mangrove transition zone
- Lower salinities in the southern lakes region (Seven Palm Lake, Little Madeira Bay and Joe Bays)

Mid-term Ecosystem Goals:

- Increase in freshwater prey fish populations in the southern mangrove zone
- Increase in the productivity of the southern mangrove transition zone and northeastern Florida Bay, i.e. improved ability of the region to support more wildlife

Long-term Ecosystem Goals:

- Increase in nesting Roseate Spoonbills in northeast Florida Bay
- Increase in wintering waterfowl usage of the lakes imbedded in the southern mangrove zone

If adequate freshwater flows are generated by the C-111SCWP project operations, the southern mangrove zone and northeastern Florida Bay will begin to exhibit such ecosystem responses, which will become more dramatic as those flows are sustained for longer periods of time. For example, a rebound in submerged grasses should eventually lead to a greater food base allowing increased nesting efforts by roseate spoonbills.

The strategy used in this report to evaluate the project was to first identify a year with a similar rainfall pattern at the regional scale to the reporting year. Frezza et al. (2008) demonstrated that local rainfall was largely the determinant of salinity patterns in the mangrove ecotone, however, the goal of the C-111SCWP was to restore a more natural flow regime from upstream thereby resulting in a salinity regime that was more representative of the regional rainfall pattern. Therefore, a similar rainfall year on the regional scale was first identified. Regional rainfall is representative of the greater Everglades watershed and is defined in this report as the entirety of southern peninsular Florida up to Stuart on the east coast and Punta Gorda on the west coast. A complete, uninterrupted rainfall record to present for this entire area was not adequate until the wet season of 1993. For this reason, the period of record for comparative purposes in this report starts in the 1993-94 hydrologic year.

To determine similarities in temporal rainfall, NMDS was performed on the mean monthly rainfall from regional rainfall collection stations. In essence, the NMDS ordination technique arranges 'objects' (in this case years) in a 2 dimensional space so as to reproduce the observed distances. This allows us to explain observed similarities or dissimilarities (distances) between the investigated objects. When plotted, points that are relatively close to each other represent distributions with similar patterns. As with many ordination techniques, the actual orientation of axes in the 2 dimensional graph is arbitrary (Statsoft 1995). Once comparable rainfall years have been identified, comparisons of mangrove hydrology, submerged aquatic vegetation and aspects of the fish community can be made between the years to see what effects, if any, the C-111SCWP project had on the coastal wetland ecosystem. Within this project initiative, the nine independent research sites are grouped into three distinct watersheds: 1) Taylor Slough (TS), 2) C-111, and 3) Southern Biscayne Bay (SBB). These divisions are based on geomorphology and prior results of analyses of rainfall, flow, and hydrologic conditions across this region. Hydrologic and biologic information within this research scope were analyzed and reported according to watershed with the following site groupings: TS watershed = TR, EC, WJ sites; C-111 watershed = JB, SB, HC sites; SBB watershed = MB, BS, CS sites (Figure 1).

Previous analyses (Lorenz 2000) have indicated two major effects of upstream water management practices on the mangrove ecosystem bordering the northern shoreline of eastern Florida Bay. The first was that diversion of natural flows resulted in alterations of the salinity regime in the mangrove zone (McIvor et al. 1994, Lorenz et al. 2003, Lorenz 2013a). The change in salinity patterns negatively affected primary production in the submerged aquatic vegetation (SAV) community within the mangrove zone (Montague and Ley 1993, Frezza et al. 2003) which, in turn, resulted in lower abundance of prey base fishes (Ley et al. 1994, Lorenz 1999, Lorenz 2000). The observed decline in productivity within the prey base fishes likely explains declines in predator populations dependent on this food resource (Bancroft et al. 1994, Lorenz et al. 2002, Lorenz 2013a). The second major effect of water management was that pulse releases of water from the canal system during the dry season resulted in reversals of the seasonal drying patterns within the coastal mangrove ecosystem (Lorenz 2000). Drying events are critical to the ecosystem in that myriad predators take advantage of a highly abundant food source in the form of prey base fishes concentrated into the remaining small pools (Kushlan 1976a, Kushlan 1976b, Loftus and Kushlan 1987, Lorenz 2000, Lorenz 2013b). Wading birds (including Roseate Spoonbills) time nesting to these drying events which enables them to readily meet the high energetic requirements of their rapidly growing young (Frederick and Colopy 1989, Bjork and Powell 1994, Lorenz 2000, Dumas 2000, Lorenz 2013b). Anthropogenic reversals in the drying pattern allow prey base fishes to spread out across the landscape making them relatively unavailable to wading birds, thereby resulting in nesting failure (Lorenz 2013b). The depth at which fish begin to move into deeper habitats (i.e., begin to concentrate) is when water levels on the wetland surface drops below about 13 cm (Lorenz 2013b).

Based on these previous findings, desirable conditions that promote a healthy ecosystem can be identified. Ideally, there should be a great deal of intra-annual variation in hydrology and hydrography. During the wet season, lower salinity within the mangrove wetlands is desirable. High wet season water levels and relatively large flows through Taylor Slough would result in the desired condition (Lorenz et al. 2003). Prey fishes would be expected to respond by increasing numbers under these low salinity conditions (Lorenz and Serafy 2006). During the dry season, low water levels and curtailment of reversals are desirable. These conditions would be promoted by reduced flows through the C-111 canal (Lorenz et al. 2003, Lorenz 2013a). The expected biological response to these conditions would be relatively high availability of prey and relatively high reproductive output by wading birds.

A Conceptual Ecological Model (CEM) of this hypothesis tailored to the trophic linkages specifically associated with roseate spoonbill nesting activities in Florida Bay is presented in Figure 4. The main drivers are the effects of rainfall and water management practices on salinity and water level in the coastal estuaries. We use regional and local rainfall data as well as freshwater flows at Taylor Slough Bridge and discharge from the C-111 canal as parameters for these drivers. As also indicated by the CEM, the effects of rainfall and water management on salinity are also dependent on the antecedent conditions at the time of the start of the report period.

Salinity and water levels are the principal stressors of the model, as these parameters directly affect the biota at the lower trophic levels (specifically SAV and prey base fish production and availability) in the coastal ecotone (Figure 4). Lorenz and Frezza (2008) documented the direct statistical relationship between salinity and SAV and also made inferences about the effects of SAV on prey base fishes (by providing food and habitat). The model also shows the direct effects of salinity on prey fish production, as documented by Lorenz and Serafy (2006). The CEM indicates that water level has a direct impact on prey fish production by determining the amount of time (i.e., hydroperiod) and space available for fish to reproduce during the wet season (Loftus and Ecklund 1994, Lorenz 1999, Lorenz 2000, Trexler et al. 2002). During the dry season, receding water levels further influence the prey fishes by concentrating them into shallow pools and creeks where they are subject to predation by higher trophic levels (Kushlan 1980, Loftus and Kushlan 1987, DeAngelis et al. 1997, Lorenz 2000, Gawlik 2002, Lorenz 2013b). Spoonbills nesting in Florida Bay depend on these concentration events to successfully meet the high energetic demands of their rapidly growing young (Lorenz 2013b) and this success rate determines the number of nesting pairs there will be in future years (Lorenz 2013b).

METHODS

Hourly rainfall data are recorded across the greater Everglades ecosystem by means of a multi-agency network of rainfall collection gauges. To supplement Audubon Florida rainfall information within the local southern Everglades coastal zone, rainfall data were acquired from Everglades National Park (ENP 2013). Hourly rainfall data across regional southern Florida are recorded by the National Oceanic and Atmospheric Administration (NOAA) and reported within two distinct climatic divisions: Everglades/SW Coast and Lower East Coast (NOAA 2013). Table 1 denotes all rainfall gauges used in these analyses and the corresponding collecting agency and Figure 5 shows these locations spatially. Daily sums are generated from the hourly rainfall data for each rain gauge location. The daily sums from each of the individual gauges within the local and regional areas were averaged to generate a single daily sum (inches) of rainfall for these two geographical areas. Using these data, exceedance curves of annual and seasonal rainfall were created for the period 1993-2013 for both the local and regional areas.

Flow rates at Taylor Slough Bridge were measured by ENP staff and were acquired from Christa Walker (ENP 2013). Flow rates at the S-197, S-18C, S-199 and S-200 structures on the C-111 canal were obtained from the South Florida Water Management District (SFWMD) via the DBHydro website. Discharges from C-111 toward Florida Bay were calculated by subtracting the flow at S-197 from that at the S-18C.

All Audubon monitoring sites are equipped with hydrologic data collection platforms (dcp's), created by Remote Data Inc., which use Hydrolab© multi sensor transmitters and Campbell© dataloggers to continuously monitor (hourly recordings) and log water levels, salinity, and temperature. At each site, water level is referenced to a staff gauge that uses a local datum that measures stage in cm increments. The staff gauge is calibrated to read zero when the local flats sub-habitat is completely dry. The multi sensor transmitters are located on site in creek habitat within 4 inch screen-slotted PVC tubes with the bottom of the sensor situated approximately 5 cm above the level of the substrate. The dcp's are routinely serviced every other month and/or when specific repairs or maintenance are needed. Daily averages of water level, salinity, and temperature are generated from the 24 hourly recordings for each site.

Submerged aquatic vegetation (SAV) is non-destructively surveyed bimonthly, during the months of July, September, November, January, March and May, at several fixed locations along the coastal estuarine salinity gradient at each of the nine sites within northeastern Florida Bay and southern Biscayne Bay (Figures 6 & 7). During the comparison year time period, SAV surveys were being performed every six weeks which resulted in a 2 month (November and May) void in data in relation to subject year survey months. Data for these two months were interpolated by taking an average from the before and after survey months to allow for comparison to the subject year. Among sites, there are a disparate number of sub-sites that are independently surveyed for SAV along the salinity gradient (Table 2). Abundance estimates of SAV are assessed using a point intercept percent coverage method which employs a 0.25 m^2 quadrat with 25 points (Morrison 1988). Quadrats are thrown into 12 locations at random to provide a range of estimates for each surveying location. Within each quadrat, total SAV percent coverage is determined by counting the number of points contacting any vegetation, indiscriminate of species type. Coverage of individual species is then determined by counting the number of points contacting a particular species. These numbers are used to obtain estimates of percent coverage. Total SAV % cover along with % cover of *Ruppia maritima* (widgeon grass) is reported herein. Emphasis is placed on *Ruppia* because the established Florida Bay Minimum Flow and Level (MFL) rule (SFWMD 2006) has set a salinity target for the mangrove transition zone based on a goal to sustain SAV in this region, particularly in regards to *Ruppia.* Similar to the MFL rule for Florida Bay, CERP's REstoration COordination and VERification (RECOVER) program specifically targets the spatial expansion of the transition zone's SAV habitat. The potential for such an expansion (particularly regarding the growth of *Ruppia* in Florida Bay nearshore waters) has been demonstrated by model evaluations (Fourqurean et al. 2003).

In order to relate *in-situ* hydrologic and hydrographic conditions with SAV abundance and species distribution, the following physical data are taken prior to each surveying event: water temperature (^{o}C), water depth (cm), salinity, and sediment depth (cm) to bedrock. An 8 inch secchi disk is used to measure water clarity. In reporting these data (in reference to Tables 3-7), 'Salinity' and 'Water Temperature' were measured using a YSI EC300. 'Water Depth' is the average water depth for quadrats surveyed and was measured using a pipe marked in 1 cm increments. 'Secchi Depth' is a measure of water clarity based on the 8" secchi disk reading. 'Bottom' indicates Secchi depth exceeded water depth. 'Sediment Depth' is the average of 3 measurements of sediment down to bedrock and was measured using a pipe marked in 1 cm increments.

The emergent vegetation species *Eleocharis cellulosa* (Broadhead spikerush) is also non-destructively surveyed every eight weeks along with the SAV monitoring at the TR, JB, and HC monitoring sites. At each of these three sites, five 0.5m^2 quadrats were permanently placed in the wetlands where *Eleocharis* was originally (spring of 1996) present in varying densities. At each site, individual quadrats were located within 200 yards of each other. During each visit, all emergent shoots and stems of *Eleocharis* located within individual quadrats were counted. Canopy height, along with maximum stem length was also recorded for each quadrat.

A 9m^2 drop net method for sampling prey base fishes was developed for this study and has been demonstrated to be an effective sampling method (Lorenz et al., 1997). Each net surrounded an individual dwarf mangrove tree, thereby sampling both prop root habitat and the open area between trees. Three nets were sampled in each microhabitat (creek and flats) at each site, for a total of six nets per sample. The relatively small variance within microhabitat versus the substantial variance between microhabitat (i.e., creeks generally have more fish than flats) indicated that this type of sampling stratification was necessary (Snedacor and Cochran 1967). Sample collections were made in June, September, and monthly from November through April. The dates that samples were collected during 2012-13 for all prey base fish sampling sites are listed in Table 8. Lorenz et al., (1997) and Lorenz (1999) provide complete details regarding fish collections and statistical treatment of these data. Different scales for the y-axis were used for charts representing data from the Card Sound site due to a prominent difference in the density and biomass levels found at this site in comparison to the other sites.

All fish collected were classified according to the Venice System of Estuarine Classification which defines salinity levels as follows: Freshwater = 0-0.99 psu, Oligohaline = 1-4.99 psu, Mesohaline = 5-17.99 psu, Polyhaline = 18-30 psu, and Euhaline = >30 psu (Bulger et al., 1993). Each fish taxa was assigned to one of each of these classifications using the methods of Lorenz and Serafy 2006. A minimum of 20 individual fish were needed to determine the appropriate salinity class. An unknown category was used for species for which a salinity class has not yet been determined. The percent of catch made up by each salinity category were calculated for each monthly sample collection within each watershed.

There are two distinct metrics in measuring fish numbers: the abundance of fish in relation to the size of the wetland (fish abundance) and the concentration of fish into smaller pockets as the wetted area of the wetland fluctuates due to the rising and lowering of water levels (fish availability). The former is calculated using a weighted stratified mean (Snedacor and Cochran 1967) where each collection is weighted by the percentage of potential flooded sub-habitat (creek or flats) that is actually inundated at the time of sample collection. For example, if a site is 25% creek sub-habitat and 75% flats sub-habitat, and the water levels are such that the entire wetland is inundated at the time of the collection, then the estimated number of fish per m^2 on the creeks is multiplied by 0.25 and that of the flats is multiplied by 0.75. The two estimates are then added together to get the stratified mean (or the abundance estimate). Conversely, if water levels were such that 25% of the potential wetted habitat was dry, then the flats estimate would be multiplied by 0.50 and the creek estimate multiplied by 0.25, and then the two added together to get the abundance estimate. This technique answers the question: how many fish are there if we correct for the concentration affect of fluctuating water levels? The second technique, prey availability, is important to understanding how a predator perceives the availability of these prey species. A foraging wading bird has no concern for how many fish the wetland would have if it were flooded, rather it is only concerned with how concentrated the prey are right at its feet. Availability is estimated simply by determining which sub-habitat (creek or flats) has the highest overall number of fish per m^2 of trap sampled. If the flats are completely dry and we collect an average of 900 fish per 9 m^2 trap in the creeks, then the estimated available number of fish is $100/m^2$; i.e., there is no correction term for the amount of the habitat that is wetted. Abundance and availability are reported in both fish number (# $fish/m^2$) and biomass (g/m^2).

Critical regions for all Analyses of Variance (ANOVA) were set at the traditional $p<0.05$. Multiple comparison procedures (i.e. *post hoc* tests) were performed for each significant ANOVA. Unless otherwise indicated, the critical region for *post hoc* tests was set at $p<0.01$ thus reducing the likelihood of increased Type I errors caused by multiple *post hoc* tests (Sokal and Rohlf 1980). The post hoc test used was Tukey's Honest Significant Difference (HSD) (Statsoft 1995). The degrees of freedom (df) for the analysis are written as a subscript after F, where the first number describes the df of the model (or between groups) and the second number describes the df for the error (or within groups).

RESULTS AND DISCUSSION

Rainfall Comparison Between Years

Although total quantity of rainfall across southern Florida is critical to understanding hydropatterns in the southern Everglades, the timing of rainfall is as important when making comparisons between years. Non-linear Multidimensional Scaling (NMDS) was performed on mean monthly rainfall for each of the 50 locations (i.e., one datum per month per location) from the regional watershed in an effort to analyze intra-annual rainfall patterns from the 1993-94HY through 2012-13HY. Based on the results of NMDS, 2008-09 was identified as the year most similar in rainfall patterns to the subject year (Figure 8). We can therefore conclude that the Everglades system had approximately the same rainfall-driven hydropatterns in 2012-13 and 2008-09.

In an effort to further examine and compare rainfall accumulation between these two years and also rainfall over this entire period of record (1993-2013), an exceedance curve of annual and seasonal rainfall was created for the regional watershed (Figure 9). The exceedance curve indicates that the total annual rainfall during the comparison year (2008-09) was similar to that of the subject year; however, annual rainfall accumulation was slightly greater in 2012-13 than in 2008-09. Total annual rainfall accumulation of 59.3 inches in 2012-13 was 5.7 more inches than in 2008-09. Both years were also very typical in annual rainfall in comparison to the

20 year period of record with both years having a return frequency of close to every other year. Only one year separated the two over the period with 2012-13 falling just above the median and 2008-09 just below. Based on the stations used in this analysis, the 20 year mean of annual rainfall in this watershed is 56 inches. Rainfall accumulation during 2012-13 was 3.3 inches greater (5.9%) than average and during 2008-09 it was 2.4 inches less (4.3%).

Wet season rainfall totals were close to identical (Figure 9) with only a 0.7 inch difference between the two years. There was disparity though with dry season rain with 2012-13 having 6 more inches than in 2008-09. However, an analysis of monthly rainfall totals (Figure 10) shows that monthly rainfall patterns were very similar up until late into the dry season. 4.5 out of the 6 inch difference in dry season rainfall between the two years are accounted for during the month of April. Besides this deviation during this single month late in the year, temporal rain patterns were quite similar between the two years. An annual rainfall accumulation graph (Figure 11) reveals that accumulation was nearly identical between the two years up until the late wet season.

Rainfall Discussion. The C-111SCWP should mitigate the imbalance in water delivery to Florida Bay by enhancing connectivity of water flows throughout the system. If the project is successful, it will achieve its primary purpose of adding a regional effect to a traditionally locally driven system. The results from these analyses of regional rainfall indicate that 2008-09 and 2012-13 were extremely similar in terms of temporal and spatial rainfall patterns. Thus we conclude that 2008-09 should serve as an excellent comparison year to 2012-13, which allows for examination of the effects of the newly operational C-111SCWP. While our results indicate that an average of 5.7 inches more rain were recorded during 2012-13, this surplus is almost entirely accounted for during the late dry season when rainfall becomes negligible and when effects of rainfall on local hydrology and biology would be least impactful. We do not expect this slight surplus of rain to be significant enough to account for any differences we may find in hydrologic or biotic factors between years. Also noteworthy is that the exceedance curves determined that annual rainfall totals during both the subject and comparison years very close to average conditions compared to rainfall totals over the last 20 years. These typical rainfall totals will allow us to draw logical conclusions of the effects of the C-111SCWP project on hydrologic or biotic factors during the subject year if anomalous results are revealed.

Antecedent rainfall conditions are also a factor in determining hydrologic conditions (Figure 4) in the mangrove zone during a given year and have been taken into account during past annual analyses. However, the 2011-12HY was an extremely anomalous year (Lorenz et al. 2013) and rainfall distribution was so atypical that taking antecedent rainfall into account when choosing a comparison year was impractical with this report. There were clearly different antecedent conditions between 2008-09 and 2012-13 as can be seen in Figure 12 where June salinity in 2008 was greater than 30 psu while in 2012 it was about 5 psu. Since we cannot take into account antecedent conditions because 2011-12 was such an odd rainfall year we simply accept antecedent rainfall conditions to 2012-13 as they are and do not take this into consideration during this analysis. The reader should take this into account when considering our results and conclusions.

The similarity in rainfall between the two years allows for a direct comparison between the impacts of water management on other physical and the biological components of the coastal wetland ecosystem. As a result, we can assume that in the absence of changes in water management practices, years with similar rainfall patterns should result in similar flow, salinity and water level patterns in the coastal mangrove zone. However, we expect that the implementation of the C-111SCWP would result in increased flow volumes through Taylor Slough and subsequent minimization of discharge out of the C-111 canal. Therefore our expectations are that flow in Taylor Slough would be greater and C-111 discharge less in the 2012-13 subject year compared to 2008-09.

Flow Comparison Between Years

A comparison of annual flow volumes in Taylor Slough and through the C-111 canal (Figure 3) indicates that under years of similar flow at Taylor Slough Bridge (TSB), there was comparatively much less discharge out of the C-111 canal during 2012-13. During 2012-13, there were 23,000 acre-ft less combined flow through Taylor Slough and C-111 than in 2008-09, however, Taylor Slough flow was greater and C-111 discharge was less in 2012-13 than in 2008-09. In a previous annual report (Lorenz et al. 2013), we documented that the volume of water discharged annually from the C-111 canal was on average 2.6 times greater than the volume that sheet flowed through Taylor Slough over the period of record (17 years). A linear regression also indicated that discharge from the C-111 had been increasing in proportion to flow through Taylor Slough over the period of record. This was a trend that we expected would be mitigated with operation of the C-111SCWP. Comparisons of these ratios of flow between C-111 and Taylor Slough for the period of record including 2012-13 are shown in Figure 13. The ratio of flow between C-111 and Taylor Slough (1.3:1) was the lowest during 2012-13 than in any other year over this period of record and exactly half that of the long term mean ratio of 2.6:1. In comparison, during 2008-09, the ratio of flow was 2.8:1, more than double that of 2012-13.

Exceedance curves for flows at TSB, discharge out of C-111, and flow at the S-197 structure were created using the annual hydrologic year flows for the entire 20 year period (Figures 14 - 16). The exceedance curve for Taylor Slough Bridge indicates that flow volumes during 2012-13 were quite substantial, having the third greatest total annual flow out of the past 20 years with a return frequency of only 1.5 years out of 10, (Figure 14). Total annual flow at Taylor Slough Bridge was 95,400 acre-ft during 2012-13. This was 32,000 acre-ft more flow than average in relation to the previous 19 year period. In comparison, flow at Taylor Slough Bridge during 2008-09 was average, representing the median value over this period of record and being equaled or exceeded every other year (Figure 14). There was a 49% increase in total annual flow through Taylor Slough in 2012-13 compared to 2008-09. The exceedance curve also shows that wet season flow at Taylor Slough Bridge during 2012-13 was the highest out of this 20 year period. In comparison, wet season flow during 2008-09 was slightly below what is typically observed, having a return frequency of 3 out of every 5 years. On average over this 20 year period of record, dry season flow at Taylor Slough Bridge has accounted for 14% of total annual flow. Dry season flows during 2008-09 were ordinary, accounting for 13% of total annual flow. In contrast, dry season flow during 2012-13 only accounted for 6% of total flow.

It is noteworthy that both total and wet season flow at Taylor Slough Bridge during 2012-13 was significant in comparison to this period of record, given the annual rainfall total. The 2 years (1999-00 and 1997-98) in which flow exceeded that of 2012-13 are represented by the 2nd and 3rd highest annual rainfall total years (Figure 9), while 2012-13 represented the 9th highest, only one above the median value.

An exceedance curve for C-111 discharge (Figure 15) indicates that in comparison to 2008-09, discharge during 2012-13 was greatly minimized: 54,000 less acre-ft of water was discharged out of the C-111 canal during 2012-13. Wet season discharge during 2008-09 was the second highest out of the observation period, having more volume than the entire annual discharge during 2012-13. Dry season discharges during both 2012-13 and 2008-09 were standard based on percentage of annual flow volumes. Despite substantially less water that was moved through the S-18C structure during 2012-13, more than twice the volume of water was released through the S-197 structure during 2012-13 than in 2008-09 (Figure 16).

The new S-199 and S-200 pump structures along the C-111 canal became operational at the beginning of the wet season, 2012. Water was first released through S-199 on July 14, 2012 and S-200 on June 20, 2012. A chart showing total monthly flow volumes through both these structures during 2012-13 in relation to monthly flow at Taylor Slough Bridge and C-111 canal is shown in Figure 17. 24,000 acre-ft more water was released through S-200 than S-199 over the course of the year. It is noteworthy that combined annual flow between S-199 and S-200 was greater than the annual flow recorded at Taylor Slough Bridge. However, annual C-111 discharge still exceeded the combined S-199 and S-200 annual flow by 21,000 acre-ft.

Flow Discussion. Based on these examinations of flow during 2012-13 in comparison to 2008-09 and the previous 20 year record, it appears that the C-111SCWP project in its initial year of operation has already begun to achieve the desirable effects of minimizing flows through the C-111 canal while increasing flow at Taylor Slough Bridge. Annual flow at Taylor Slough Bridge increased 49% in comparison to 2008-09 while annual discharge out of the C-111 canal decreased 30%. Due to the similarities in spatial and temporal rain patterns between the subject and comparison year, we conclude that the changes in flow volumes experienced during 2012-13 occurred as a result of the hydrologic modifications made by operation of the C-111SCWP project and were not a function of increased rainfall throughout the region.

An explanation of the dynamics behind new and existing infrastructure along the C-111 canal network allows for a better understanding of how the C-111SCWP project has resulted in these new hydrologic developments. Water released at the S-199 and S-200 structures is transported via slough-ways into the Frog Pond Detention area and the Aerojet Canals region on the eastern side of the L-31W canal. This transport of water out of the C-111 canal via the two new pump stations has achieved the desired conditions of increased head within these two water detention areas. This increase in head (or water level) in Taylor Slough along the eastern periphery of Everglades National Park has enabled the S-332D pump station to become more efficient at moving water towards the Taylor Slough marsh at the S-332 B, C, and D pump stations and from minimizing seepage of this water back to the east. The fate of the water pumped at S-199 and S-200 is most likely into the L-31W, then back to C-111 and eventually southern Dade groundwater. However, even if the water ends up back in C-111, it served the beneficial purpose of keeping water that was in Taylor Slough in the Slough by building up the necessary head to reduce seepage from the Slough back into the canal. The main benefits arise from building up the head adjacent to the Park with the energy from the pumps (personal communication, Kevin Kotun, ENP 2013).

A reduction in flow through the C-111 canal is a desirable response and also an indication that the C-111SCWP is functioning as it was planned. A comparison of wet season flow volumes at the S-177 structure to the upstream S-331 structure since 1984 indicates that by far, 2013 experienced the lowest flows through S-177, relative to S-331 (Figure 18). A time series plot of these same data shows that while the wet season of 2013 experienced the highest flow volume through S-331 since 1984, flow at S-177 was comparatively very low (Figure 19). This is also representative of the positive effects of the C-111 detention areas that came online in 2000, but were not fully operational until 2009 (personal communication, Kevin Kotun, ENP 2013).

Despite substantially less water that was discharged through the S-18C structure during 2012-13, more than twice the volume of water was released through the S-197 structure during 2012-13 than in 2008-09 (Figure 16). The vast majority (68%) of this water was released at the end of August, 2012 in preparation for tropical storm Issac. The gates were also opened on April 3, 2013 to run a test on new gears that were installed on the new gear box as part of the reconstruction of the S-197 gate itself, which was completed in January, 2013 (personal communication, Sam Palermo, SFWMD, Engineering and Construction Bureau 2013). These two factors account for the discrepancy in discharge at S-197 between years. Regardless of the discrepancy, the volume of water released at S-197 during 2012-13 is most likely inconsequential as it represented only 8% of the volume that was released through S-18C and represented the 7^{th} lowest flow volume at S-197 out of the last 20 years.

While this preliminary assessment of the C-111SCWP has shown positive initial results, it is most likely too early to make any final assessments on capabilities of the project to achieve long term goals. Yet to be determined is how much impact the Frog Pond detention area will have on keeping water in Taylor Slough during the dry season. Comparatively higher rainfall in the late dry season during 2012-13, specifically in April, does not allow us to draw conclusions about these effects. Despite the increased rain in April, dry season flow at Taylor Slough Bridge was comparatively low during 2012-13. Realistic proof of proper function of the C-111SCWP will be in the sustained reduction of C-111 canal flow. Flow at S-176 has decreased substantially since S-332 B, C, and D came online, and now a similar response is being observed at S-177 and S-18C. However, it may take at least 5 to 10 years before solid conclusions can be drawn (personal communication, Kevin Kotun, ENP 2013).

Based on the results of these analyses of flow, our expectations are that the downstream mangrove transition zone will have experienced significantly longer hydroperiod and lower salinity levels in 2012-13 than in 2008-09 in response to the increase in Taylor Slough flow and minimized C-111 discharge.

Water Level and Salinity Comparison Between Years

As expected in response to increased Taylor Slough flow and minimized C-111 discharge, the downstream mangrove transition zone experienced significantly higher mean relative water levels and lower salinities in 2012-13 than in 2008-09. A comparison of water levels for the subject and comparison years of the three watersheds in the downstream mangrove transition zone, TS, C-111, and SBB, is presented in Figure 20 (B) along with monthly averages for the three watersheds combined (A). The ANOVA of water level (3 watersheds combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) in water level between years for 11 of 12 months, with the exception of the month of August (Figure 20A). With the exception of the months from August to October, water levels were higher in 2012-13 by an average of 11.4 cm. Eliminating the month of August in which water levels differed by < 1 cm and were not significantly different, water levels were higher in 2008-09 during the months of September and October by an average of 8.9 cm.

The mean water levels within all three watersheds were significantly different between the subject and comparison years ($p<0.05$; Figure 20B). The *post hoc* test indicated that water levels were significantly higher ($p<0.01$) in 2012-13 for all three watersheds combined by an average of 6.9 cm. Water levels were higher in 2012-13 by 9.4 cm in TS, 6.8 cm in C-111, and 4.6 cm in SBB. Subdivided into wet season (June 1 to November 30) and dry season (December

1 to May 31), water levels were significantly ($p<0.05$) higher in 2012-13 during both seasons for all three watersheds with the exception of the SBB wet season in which water levels were higher in 2008-09, but not significantly different from the subject year (Figure 21A-B). The *post hoc* test indicated that water levels were significantly higher ($p<0.01$) in 2012-13 for all three watersheds during the dry season by an average of 10.7 cm (Figure 21B). During the wet season, water levels were significantly higher ($p<0.01$) as indicated by the *post hoc* test in the TS and C-111 watersheds by an average of 5.6 cm. In the SBB watershed, water levels were not significantly different during the wet season and differed by only 1.6 cm.

The three-way interaction of Year by Watershed by Month (Figure 22) for water level was also significant ($p<0.05$). The *post hoc* test revealed that water levels were significantly higher ($p<0.01$) in 2012-13 in all three watersheds during the month of June and from November to May by an average of 12.7 cm in TS, 11.9 cm in C-111, and 10.9 cm in SBB. Additionally, the *post hoc* test revealed that water levels were higher in 2012-13 in TS and C-111 during the month of July by an average of 11.8 cm but not in SBB where water levels differed by only 1.7 cm. Water levels were only significantly higher as indicated in the *post hoc* test ($p<0.01$) in 2008-09 in all three watersheds during the month of September by 6.2 cm in TS, 13.7 cm in C-111, and 24.5 cm in SBB.

To make comparisons of water level across the 20 year period of record, exceedance curves were created for all three watersheds (Figure 23). Overall, water levels in 2012-13 were higher than in 2008-09 and were rarely if at all exceeded during the 20 year period. Both annual and wet season water levels in 2012-13 were the highest recorded across the 20 year period of record for all three watersheds with the exception of SBB in which the wet season water level was the second highest recorded. The average annual water level in 2012-13 was 26.9 cm and the average wet season water level was 34.2 cm. Dry season water levels in 2012-13 were the highest recorded across the 20 year period of record for SBB, the second highest recorded for C-111 and the fourth highest for TS. Average dry season water level in 2012-13 for all three watersheds combined was 19.6 cm. 2008-09 water levels averaged 18.9 cm annually, 28.7 cm in the wet season and 9.0 cm in the dry season. Water levels in 2008-09 were equaled or exceeded on average 50% of the time or less across the 20 year period of record with the exception of wet season water levels for C-111 and SBB which occurred 30% and 25% of the time in 20 years, respectively.

An expected response of significantly lower salinities in 2012-13 compared to 2008-09 in response to increased Taylor Slough flow and minimized C-111 discharge was observed. A comparison of mean salinity for the subject and comparison years of the three watersheds is presented in Figure 12 (B) along with monthly averages for the three watersheds combined (A). The ANOVA of mean salinity (3 watersheds combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) in salinity between years for 8 of 12 months (Figure 12). Salinities were lower in 2012-13 from June to September and from March to May by an average of 16.5 psu. The only month in which salinities were significantly lower in 2008-09 was the month of November by 2.9 psu.

The salinities of all three watersheds were significantly different between the subject and comparison years ($p<0.05$; Figure 12). The *post hoc* test indicated that salinities were significantly lower ($p<0.01$) in 2012-13 for all three watersheds by an average of 9.6 psu. Salinities were lower in 2012-13 by 12.7 psu in TS, 6.7 psu in C-111, and 9.5 psu in SBB.

The three-way interaction of Year by Watershed by Month (Figure 24) for salinity was also significant ($p<0.05$). The *post hoc* test revealed that salinities were significantly lower ($p<0.01$) in 2012-13 in all three watersheds during the month of June to September and from March to May by an average of 21.6 psu in TS, 13.6 psu in C-111, and 17.7 psu in SBB. Additionally, the *post hoc* test revealed that salinities were significantly lower ($p<0.01$) in 2012-13 in SBB during the month of October by 5.1 psu. Of the three watersheds, only in C-111 during the months of November and December were salinities significantly lower in 2008-09 as indicated in the *post hoc* test ($p<0.01$) by an average of 5.7 psu.

To make comparisons of salinities across the 20 year period of record, exceedance curves were created for all three watersheds (Figure 25). Overall, salinity levels in the TS watershed during 2012-13 were very low in comparison to the past 20 years. Annual mean salinity (all sites combined) in 2012-13 averaged 9.6 psu and were equaled or exceeded 50% of the time or more within all three watersheds. Annual mean salinity within the TS watershed during 2012-13 was the second lowest out of this period, being equaled or exceeded 95% of the time. In comparison, annual salinities in the C-111 and SBB watersheds were an average of 11.0 psu greater, combined, than in TS and were equaled or exceeded much less, 45% of the time in C-111 and 75% of the time in SBB. Annual mean salinities in 2008-09, overall, were the second highest recorded for all three watersheds and were equaled or exceeded 20% or less of the time across the 20 year period of record. The dry season salinity in SBB was the highest recorded across the 20 year period of record at 36 psu.

<u>Hydrology Discussion.</u> With the completion of the C-111SCWP in January 2012 and, subsequently, the start of operations at the beginning of the 2012 wet season, analyses indicate that flows through the C-111 canal are being minimized while flows at the Taylor Slough Bridge are increasing. The early stages of achieving the short-term goal of restoring a more natural flow regime from upstream to produce increased freshwater conditions more representative of the regional rainfall pattern in the mangrove transition zone is evident in the higher water levels and lower salinities of 2012-13 as compared to 2008-09.

Historically, the amount of fresh water received by the TS, C-111, and SBB watersheds from the Everglades decreased from west to east as based on site proximity to Taylor Slough (Figure 1). Mean water levels were higher in 2012-13 by 9.4 cm in TS, 6.8 cm in C-111, and 4.6 cm in SBB (Figure 20B). Across all watersheds combined (Figure 20A) and distinctly within each watershed (Figure 22), mean water levels were greater in 2012-13 by an average of 11.4 cm overall (Figure 20) from November 2012 to June 2013, a period of time encompassing the entire dry season (Figure 21) and early into the wet season. During those months, water levels in 2012-13 exceeded those in 2008-09 by 12.7 cm in TS, 11.9 cm in C-111, and 10.9 cm in SBB (Figure 22). Although water levels in the wet season of 2012-13 exceeded those in 2008-09 in the TS and C-111 watersheds by an average of 5.6 cm (Figure 21A), water levels in the SBB watershed were greater in 2008-09 by 1.6 cm. In all three watersheds, water levels were higher in 2008-09 in the middle wet season, particularly during the month of September (Figure 22) by an average of 8.9 cm combined (Figure 20A). In the C-111 and SBB watersheds, water levels were uncharacteristically high during the wet season of 2008-09 in comparison to the 20 year period of record (Figure 23). These water levels were rarely exceeded over this period.

Salinities were lower in 2012-13 in all three watersheds combined by an average of 16.5 psu during the months of June to September 2012, roughly equivalent to the wet season, and from March to May 2013, late into the dry season (Figure 12). Despite 2008-09 having high salinities of a magnitude rarely seen within the 20 year period of record, salinities during 2012-

13 were some of the lowest out of the period within the TS and SBB watersheds (Figure 25). Within the C-111 watershed, salinities during 2012-13 were comparatively higher, being equaled or exceeded on an annual and seasonal level approximately 45% of the time. Salinities were lower in all three watersheds individually by 12.7 psu in TS, 6.7 psu in C-111, and 9.5 psu in SBB (Figure 12B). All three watersheds displayed the same seasonal patterns of lower salinities for the bulk of the wet season and late into the dry season. During these periods of time, salinities were lower in 2012-13 by 21.6 psu in TS, 13.6 psu in C-111, and 17.7 psu in SBB (Figure 24). Salinities were not very different between the subject and comparison years late into the wet season and early into the dry season. Only during the months of November and December did the salinities in 2012-13 exceed those in 2008-09 by an average of 5.7 psu in the C-111 watershed (Figure 24).

Effects of Local Rainfall

While these results of analyses of flow, salinity and water levels within the mangrove ecotone are an indicator of potential early success of the C-111SCWP, the role of localized rainfall as a contributing factor to the observed differences between subject and comparison year should not be discounted. The 50 collection gauges used in the regional rainfall watershed analysis are spatially varied across southern Florida and are representative of the greater Everglades ecosystem (Figure 5). Many of the collection locations though are not located within the localized watershed of northeastern Florida Bay. Frezza et al. (2008) demonstrated that local rainfall was a large determinant of salinity dynamics in the mangrove ecotone and that rainfall patterns in the Taylor Slough/Panhandle (TS/Ph) region are not always consistent with those in the greater Everglades region. To determine if there were differences in localized rainfall between the subject and comparison years that could account for the observed and herein reported hydrologic differences, we analyzed rainfall data from 30 rain collection gauges specifically in the watershed of northeastern Florida Bay south of Tamiami Trail (Table 1; Figure 5) for the same period of record as regional rainfall analysis. The same methods were used for analyzing local rainfall as were used for regional rainfall analysis. Results of NMDS on local rainfall indicated that 2008-09 was also the year most similar in rainfall patterns to the subject year over the 20 year period of record (Figure 26). Exceedance curves indicate that annual and seasonal rainfall were also similar between subject and comparison years; however, like regional rainfall, annual rainfall accumulation was greater (7.2 inches) in 2012-13 than in 2008-09 (Figure 27). This surplus of rainfall in 2012-13 was accounted for during the late dry season, following the same pattern as was reported for regional rainfall. As was the case with regional rainfall, monthly rainfall totals in the local watershed were extremely similar up until April (Figure 28). Nearly the entire disparity in total rainfall between years was accounted for during this month. Besides this deviation during April, temporal rain patterns were very similar between the two years. An annual rainfall accumulation graph (Figure 29) reveals that accumulation was nearly identical between the two years up until the late wet season. Based on these results, we conclude that hydro-patterns observed during 2012-13 cannot be explained as an artifact of localized rainfall.

Effects of Card Sound Canal Restoration Project

A confounding factor to assumption of C-111SCWP attributing fully to the noted differences in hydro-patterns between subject and comparison year is that our salinity 'control' sites responded similarly to sites 'impacted' by sheetflow and water management operations in the TS/Ph region. Our Barnes Sound (BS) and Manatee Bay (MB) sites are considered control sites for salinity analyses because they are impounded by roadbeds (US-1 and Card Sound Road) and have received little to no freshwater sheet flow from the Everglades since the construction of the Florida East Coast Railroad (Currently US-1) in the early 1900's (Lorenz et al. 2003). As a result, all freshwater input to these two sites is from local rainfall or groundwater seepage, i.e., water management operational changes have only minimal impacts on the hydro-patterns of these sites. Both of these sites had similar salinity response throughout 2012-13 to the impacted sites in the TS and C-111 watersheds. If the noted differences in hydro-patterns observed and documented thus far between subject and comparison years were only a function of the **C-**111SCWP, than we would not have expected a similar response at the control sites in the SBB watershed. One explanation for similarities between control and impacted areas is that wetlands in the control area (also referred to as The Everglades Mitigation Bank) have recently been the site of a canal restoration project meant to rehydrate these wetlands. Between March 2010 and March 2012, two dams (a weir and an earthen plug) were constructed along the Card Sound Canal along the mangrove/sawgrass interface with the intent to reduce seepage of freshwater out of these wetlands into the canal and to reduce saltwater intrusion up the canal into the wetlands (Delaney 2010). We speculate that the reduced salinity conditions and increased SAV abundance (see next section) in the impounded control area during 2012-13 may be a result of this restoration project. We conducted a cursory investigation of salinity data using BACI analysis and a t test for the two year period prior to and after the restoration project was completed. Results showed no significant ($p<0.05$) differences in salinity patterns between 'before' and 'after' periods. However, we currently feel that this is not an adequate test for hydrologic changes that may have resulted from the restoration project due to the short period of record available for the 'after' period and for the lack of a measure of freshwater flow through these wetlands. This leads us to not rule out the restoration project as a function for the observed similarities in salinity between control and impacted sites during 2012-13. We will continue to monitor conditions in these wetlands and report on noted changes that may have resulted from this restoration project.

Submerged Aquatic Vegetation Community Comparison Between Years

The lower salinities observed in 2012-13 as compared to 2008-09 were expected to directly impact the biota at the lower tropic levels by creating conditions necessary for greater productivity and availability of SAV in the mangrove transition zone. Particularly, Lorenz and Frezza (2008) documented the direct statistical relationship between salinity and SAV.

Total SAV % coverage and *Ruppia maritima* % coverage were analyzed within the three watersheds to determine the downstream effects on the SAV community. The SAV appendix provides total and individual species SAV percent coverage for each site, date of collection, and physical data (salinity, water depth, Secchi depth, water temperature, and sediment depth) under which each sample was collected for the subject year. Watershed analysis of SAV includes only the sites with periods of record beginning prior to June 2008: TR1 in TS, JB1 and HC1A in C-111, and BS-1 and MB1 in SBB. CS1 was not used in the SBB analysis because the site is located in an open lake habitat downstream of the creek in which the prey base fish sample occurs.

A comparison of total SAV % coverage for the subject and comparison years is presented in Figure 30. Figure 31 provides monthly averages of total SAV % coverage for the three watersheds combined. The ANOVA of total SAV % coverage (3 watersheds combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) in total SAV % coverage between years for 5 of the 6 sample months (Figure 31). During these five months, total SAV % coverage was higher in 2012-13 by an average of 35.4%.

For all sites within the three watersheds combined, total SAV % coverage was higher in 2012-13 by an average of 32.3 %, (Figure 30). Total SAV % coverage within all three of the watersheds individually was significantly different between the subject and comparison years ($p<0.05$). The *post hoc* test indicated that total SAV % coverage was significantly higher ($p<0.01$) for all three watersheds in 2012-13 by 36.7 % in TS, 35.9% in C-111, and 26.5 % in SBB. The three-way interaction of Year by Watershed by Month (Figure 32) for total SAV % coverage was also significant ($p<0.05$). The *post hoc* test revealed that total SAV % coverage was significantly higher ($p<0.01$) in 2012-13 in all three watersheds during the month of September by 53.8% in TS, 61.8% in C-111, and 37.2% in SBB. Additionally, total SAV % coverage was significantly higher ($p<0.01$) in 2012-13 during the month of July in TS by 51% and during the months of July and November in C-111 by 38.9% and 45.2%, respectively. All of these months fall within the beginning of the wet season of 2012 and the start of C-111SCWP operations. Total SAV % coverage then began to decrease in 2012-13 from the November to May survey in TS, from the September to March survey in C-111, and from the September to January survey in SBB at a rate of decrease of 36.1%, 35.4%, and 28.5%, respectively.

Of all the species comprising the total SAV community within the southern mangrove transition zone, *Ruppia maritima* is found within sites under the widest range of water level and salinity conditions. A comparison of *Ruppia* % coverage for the subject and comparison years is presented in Figures 30 and 31 (three watersheds combined). *Ruppia* % coverage was higher in 2012-13 for all sites within the three watersheds combined by 9.1% (Figure 30). *Ruppia* % coverage of all three of the watersheds individually was only significantly different between the subject and comparison years ($p<0.05$) for SBB. Although *Ruppia* % coverage was higher for all three watersheds in 2012-13, the *post hoc* test indicated that *Ruppia* % coverage was only significantly higher ($p<0.01$) for the SBB watershed, by 27%. The ANOVA of *Ruppia* % coverage (3 watersheds combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) in *Ruppia* % coverage between years for three of the six sample months (Figure 31). During the wet season months of July, September, and November, *Ruppia* % coverage was higher in 2012-13 by an average of 12.8%. Although *Ruppia* % coverage was higher in 2012-13 from the July to January sample in TS, from the July to March sample in SBB, and for all of the sample months in C-111, the three-way interaction of Year by Watershed by Month (Figure 33) was only significant ($p<0.05$) for the SBB watershed. The *post hoc* test revealed that *Ruppia* % coverage was significantly higher ($p<0.01$) in 2012-13 in SBB during the July, September, November, January, and March samples by an average of 35.6%.

SAV Discussion. The expected response of SAV during 2012-13 in the context of the goals of the C-111SCWP, was an increase in the coverage of brackish and freshwater submerged grass and algae species in the southern mangrove transition zone with decreasing salinities. Total SAV % coverage was higher for all three watersheds in 2012-13: 36.7% in TS, 35.9% in C-111, and 26.5% in SBB. In the early wet season months of 2012-13, total SAV % coverage was significantly ($p<0.05$) higher by 53.8% in TS, 61.8% in C-111, and 37.2% in SBB. After the September survey in TS and SBB and the November survey in C-111, differences in coverage became less substantial and insignificant ($p>0.05$) for the remainder of 2012-13. Although higher SAV cover was observed in 2012-13, it should be noted that antecedent SAV coverage was comparatively higher at the end of 2011-12 than in 2007-08. The significant differences in total SAV % coverage observed in 2012-13 occur at the beginning of the wet season of 2012, followed by decreases in coverage for most of the remainder of 2012-13. The magnitude in the difference in coverage between the subject and comparison year decreased as the SAV community possibly began to respond to hydrologic changes resulting from the C-111SCWP. The magnitude and time of response is also confounded by the higher SAV cover of 2011-12 and the lag response to salinity (Frankovich et al., 2012).

We expected the coverage of *Ruppia* to respond to changes in salinity as it is a fresh to brackish water species that is likely sensitive to changes in these conditions. Combined (all watersheds), *Ruppia* % cover was 9.1% higher in 2012-13 than in 2008-09. However, it was only significantly ($p<0.05$) higher (27%) within the SBB watershed. During the early wet season, *Ruppia* % coverage was higher in 2012-13 by an average of 12.8% for all three watersheds combined. At the watershed level, only in SBB was *Ruppia* % coverage significantly higher ($p<0.01$) throughout the entire 2012-13 year by an average of 35.6 %, with the only exception being the month of May. Although *Ruppia* % coverage was higher in 2012-13 in both the TS and C-111 watersheds, the differences were not significant ($p>0.05$). Within TS and C-111, *Ruppia* % coverage decreased rapidly through 2012-13 at an average rate of 45.7% from the July - May surveys. Conversely, within SBB, *Ruppia* % coverage initially increased in the wet season of 2012-13 before rapidly decreasing at a rate of 10.7% from the March - May survey, late in the dry season.

Die-off of *Ruppia* throughout 2012-13 decreased from west to east across the mangrove transition zone, possibly supporting success of the C-111SCWP in restoring the historical pattern of fresh water delivery to the Taylor Slough watershed. This pattern was also observed in the dry season monthly rate of decrease of total SAV % coverage of 36.1 % in TS, 35.4 % in C-111, and 28.5 % in SBB.

Based upon responses in total and *Ruppia* % coverage, goals of the C-111SCWP are possibly beginning to be met. Greater SAV coverage in 2012-13 as compared to 2008-09 may be evidence that lower salinities within the southern mangrove transition zone have resulted in a more robust SAV community. Over time, the recovery of SAV communities should lead toward a more productive prey base fish community.

Emergent Vegetation Community Comparison Between Years

Three sites are surveyed for emergent vegetation on a bi-monthly basis in conjunction with the SAV surveys: TR1, JB1, and HC1. The three sites represent two of the three watersheds under consideration in this report; TR1 located in TS and JB1 and HC1 located in C-111. Due to the small sample size, JB1 and HC1 were not combined to represent the C-111 watershed but analyzed as distinct sites. A summary of emergent vegetation surveys conducted during 2012-13 is located in the Emergent Vegetation Appendix (Tables EA1 – EA3).

A comparison of the number of stems (m^2) for the subject and comparison years of the three sites is presented in Figure 34 (B) along with monthly averages for the three sites combined (A). The ANOVA of the number of stems (m^2) (3 sites combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) in the number of stems (m^2) between years for 5 of the 6 surveys (Figure 34A). The number of stems (m^2) was higher in 2012-13 by an average of 80.3 stems (m^2). The number of stems (m^2) within sites was significantly different between the subject and comparison years ($p<0.05$; Figure 34B) for TR1 and JB1. The *post hoc* test indicated that the number of stems (m^2) was significantly higher ($p<0.01$) in 2012-13 by 102.9 stems (m^2) at TR1 and 111.5 stems (m^2) at JB1. Although the difference was not significantly different at HC1, the percent increase from 2008-09 to 2012-13 was the greatest at HC1 and at least twice as great as the percent increase at both TR1 and JB1. The number of stems (m^2) increased by five times between the subject and comparison year at HC1.

As with the number of stems (m^2), a comparison of the ratio of shoots to stems for the subject and comparison years of the three sites is presented in Figure 35 (B) along with monthly averages for the three sites combined (A). The ANOVA of the shoot to stem ratio (3 sites combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) between years for 5 of the 6 surveys (Figure 35A). The average shoot to stem ratio, 1:3.3, in 2012-13 was greater than the average ratio in 2008-09, 1:1.2, by 2.1 stems per shoot. The only month in which the shoot to stem ratio was not significantly different was September in which the ratio was approximately 1:1. Within sites, shoot to stem ratio was significantly different between the subject and comparison years ($p<0.05$; Figure 35B). The *post hoc* test indicated that the ratio was significantly higher ($p<0.01$) in 2012-13 by 1.4 stems per shoot at TR1 and JB1, and by 1.3 stems per shoot at HC1.

The height of the emergent canopy for the three sites for the subject and comparison years is presented in Figure 36 (B) along with monthly averages for the three sites combined (A). The ANOVA of canopy height (3 sites combined) revealed significant two-way interactions between Month and Year ($p<0.05$). The *post hoc* test indicated that there were significant differences ($p<0.01$) between years for 4 of the 6 surveys (Figure 36A). The canopy height was higher in 2012-13 by an average of 14.0 cm. Canopy height within sites was significantly different between the subject and comparison years ($p<0.05$; Figure 36B) for TR1 and JB1. The *post hoc* test indicated that the canopy height was significantly higher ($p<0.01$) in 2012-13 by 23.0 cm at TR1 and by 13.1 cm at JB1. The difference in canopy height of 4.6 cm was not significant at HC1. Graphs of the three-way interaction of Year by Site by Month (Emergent Appendix, Figures EA1-EA3) for all three parameters of number of stems (m^2), ratio of shoots to stems, and canopy height was significant ($p<0.05$) only for the month of July at TR1. The *post hoc* test revealed that all three parameters, number of stems (m^2), ratio of shoots to stems, and canopy height, were significantly higher ($p<0.01$) in 2012-13 at TR1 during the month of July: by 143.6 stems (m^2), 2.2 stems per shoot, and 31.6 cm, respectively.

Emergent Discussion. An expected response of the emergent vegetation community during 2012-13 in the context of the goals of the C-111SCWP was an increase in the parameters of the number of stems (m^2), the ratio of shoots to stems, and the canopy height in the southern mangrove transition zone with increased hydro-period. Although the emergent vegetation community can be composed of a mix of grasses and sedges, the only type of emergent vegetation present in the quadrats during both 2012-13 and 2008-09 was *Eleocharis spp*., a genus of 250 or more species of flowering plants in the sedge family, Cyperaceae.

The number of stems, the ratio of shoots to stems, and the canopy height were higher at all three sites in 2012-13 concurrent with greater hydro-periods in the TS, C-111, and SBB watersheds. The emergent vegetation community coverage and canopy height has been shown to increase with increasing water depth (Lentz and Dunson, 1998; Busch, et al. 2004). In addition, the ratio of shoots to stems is a very good indicator of the response of a plant to changes in physical conditions. While the number of stems and canopy height were not significantly different ($p<0.01$) at HC1, the shoot to stem ratio was significantly higher in 2012-13 by 1.3 stems per shoot. The number of stems (m^2) increased by five times between the subject and comparison year at HC1. The difference in the number of stems (m^2) and canopy height at HC1 between 2012-13 and 2008-09 may not be significant because two of the five fixed quadrats are consistently void of emergent vegetation at this site. In both of these fixed quadrats, the number of stems (m^2) increased from zero in 2008-09 to an average of 7.8 stems per shoot by May of 2012-13. In addition, when no stems are present in the plot, the canopy height is, of course, zero. The significant differences in the number of stems, the ratio of shoots to stems, and the canopy height occur collectively among and between the sites; but not within the sites themselves. Although the differences were not significant within sites at $p<0.01$, the differences were in most cases an order of magnitude greater between the subject and comparison years. Increases in the emergent vegetation community may be affected most distinctly by physical changes in the watershed occurring at a more landscape scale as opposed to both locally within sites and across the landscape as in the SAV community.

The pattern of higher mean water levels in 2012-13, 9.4 cm in TS, 6.8 cm in C-111, and 4.6 cm in SBB, with proximity to Taylor Slough appears to support the hypothesis of a potential restoration of the historical pattern of the amount of fresh water received by the TS, C-111, and SBB watersheds from the Everglades decreasing from west to east (Figure 1) possibly as a result of C-111SCWP operations. The parameters of shoot to stem ratio and canopy height are both positively correlated with growth of the emergent vegetation community and have been shown to increase with increasing water depth (Busch, et al. 2004). The shoot to stem ratio increased spatially across the landscape by an average of 0.75 stems per shoot from the C-111 to TS watershed. In addition, canopy height increased by an average of 13.0 cm across the landscape from the C-111 to TS watershed. With increasing hydro-period from east to west in 2012-13, an increase in the amount of all emergent vegetation parameters was observed.

The response of the emergent vegetation community highlight increases in growth correlated with increased water levels in 2012-13, signaling possible positive biologic responses from operation of the C-111SCWP. Greater growth and abundance of the emergent vegetation community within the southern mangrove transition zone may over time provide more habitat for the prey base fish community and subsequent increase in availability of prey for tactile feeding birds during the dry season.

Prey Base Fish Comparison Between Years

Community Structure. Tables 9-13 show the percent catch by species and the percent catch by a species salinity "affinity" for each watershed. Figure 37 and Figure 38 show the annual percent catch for each individual watershed, and all three watersheds combined, respectively, based on a species salinity affinity. Even though there were far less fish collected in 2012-13, all three watersheds showed more species diversity within the fish community during 2012-13 in comparison to 2008-09.

A total of 3721 fish were collected in the Taylor Slough watershed consisting of 23 species in 2012-13 which was 1048 less fish, but 4 more species than what was collected in 2008-09 (Tables 9 and 11). Rainwater killifish were the most abundant species during both years comprising 40.8% of the annual catch in 2008-09 and 55.4% of the annual catch in 2012-13. There was a notable difference in the percentage of Mayan cichlids and sheepshead minnows between years. The amount of Mayan cichlids increased 8.0% and sheepshead minnows decreased 13.5% in 2012-13. The percentage of freshwater species was much greater in 2012-13.

In 2008-09 only 0.2% of the annual catch consisted of freshwater species, whereas in 2012-13 this number increased to 6.0%. During the month of February the percentage of freshwater species reached a peak at 26.5% of the population. Comparatively, the highest monthly percentage of freshwater species was only 1.7% of the population during December of 2008. Figure 37 shows that the higher percentage of freshwater species in 2012-13 was accompanied by a lower percentage of polyhaline species, which was 7.3% lower than that found in 2008-09.

Rainwater killifish and sheepshead minnows were the most abundant species in the C-111 watershed during both hydrologic years (Tables 13 and 15). There was a slight decrease in the percentage of oligohaline species from 74.1% in 2008-09 to 67.3% in 2012-13, while there was an increase in mesohaline species from 12.0% in 2008-09 to 18.2% in 2012-13 (Tables 14 and 16 and Figure 37). Interestingly, in concurrence with an increase in mesohaline species, there was an increase in the percentage of freshwater species from 0.8% of the annual population in 2008-09 to 2.1% in 2012-13.

In the SBB watershed, the community was dominated by the presence of clown gobies and goldspotted killifish during both the subject year and comparison year (Tables 17 and 19). SBB had slight shifts in the percentage of oligohaline, mesohaline and polyhaline species, where both oligohaline and polyhaline species decreased while the percentage of mesohaline species increased (Tables 18, 20 and Figure 37). This was most likely due to the increase in the percentage of clown gobies, a mesohaline species, from 28.0% in 2008-09 to 44.8% in 2012-13, while the percentages of gold spotted killifish, a polyhaline species, and sheepshead minnow, an oligohaline species, decreased from 33.8% to 15.7% and from 10.6% to 0.8%, respectively.

Density and Biomass. Figures 39-47 illustrate the stratified mean fish density and biomass found during each prey base fish sample at the nine prey base fish sites plotted against the daily mean salinity level for both the subject and comparison years. There was a significant year effect in density for all watersheds combined ($p<0.05$); however a post hoc test (Tukey HSD) showed there was not a significant difference at the predetermined $p<0.01$ level between 2012-13 which had a mean of 3.2 fish/m^2 (SE=0.27) and a mean of 4.18 fish/m^2 (SE=0.28) found in 2008-09 (Figure 48). There was also a significant ($p<0.005$) difference for all watersheds combined between Years and Months for stratified density, but the *post hoc* test indicated that only one month was significantly different at the predetermined $p<0.01$ (Figure 49). December 2008 showed a significant difference from December 2012 ($p<0.001$). The mean stratified density for December 2012 was 2.64 fish/m^2, where the mean stratified density for December 2008 was much higher with a mean of 7.05 fish/m^2. There were not any significant differences found in the density levels between years at the three watersheds (Figure 50).

There was a significant year effect for all watersheds combined for fish biomass ($p<0.05$) (Figure 48). The fish stratified biomass was lower in 2012-13 with a mean of 1.15 g/m^2 (SE=0.20) compared to the mean stratified biomass in 2008-09, 2.41 g/m^2 (SE= 0.20). The two-way ANOVA for Year and Month for stratified biomass was statistically significant ($p<0.001$) when all three watersheds were combined (Figure 49). Biomass results showed similar outcomes as density in that the only month that had a significant difference between the subject year and the comparison year was December. The biomass level found in December 2012 had a minimal mean of 0.61g/m^2 whereas December 2008 had a more substantial mean biomass of 4.77g/m^2. The analysis of Year and Watershed did not show any significant differences within each watershed between the subject year and the comparison year (Figure 50).

Available Biomass. The un-stratified fish available density and available biomass for each of the 16 prey base fish samples collected during 2008-09 and 2012-13 at the nine individual sites plotted against the daily mean water level is presented in Figures 51-59. When all watersheds were combined, there were significant differences between years for available density ($p<0.001$) and available biomass ($p<0.001$) (Figure 60). The annual mean for available density was 7.7 fish/m^2 (SE=0.51) in 2008-09, but in 2012-13 the available density was significantly lower at 4.84 fish/m^2 (SE=0.50). The annual available biomass level followed a similar pattern, where the available biomass was significantly higher in 2008-09 with a mean of 5.43 g/m^2 (SE=0.50) versus a lower available biomass found in 2012-13 with a mean of 1.83 g/m^2 (SE=0.49). The available density and biomass levels were higher during 2008-09 for each month sampled except during April, and a two-way ANOVA of all watersheds combined for Year and Month showed that there were significant effects on the available density ($p<0.01$) and the available biomass ($p<0.001$). However, the *post hoc* test indicated that there was only a significant difference between the available biomass levels during the month of January ($p<0.01$) (Figure 61). The available biomass level in January was 10.67 g/m^2 higher in the comparison year, 2008-09.

The Year and Watershed analysis showed that there was not a significant difference for available density or available biomass; however a *post hoc* test showed there was a significant difference between years in the C-111 watershed ($p<0.01$) (Figure 62). The mean available biomass for the C-111 watershed was 6.54 g/m^2 in 2008-09, but was only 1.26g/m^2 in 2012-13.

Prey Base Fish Discussion. The results from the analyses of the hydrologic conditions and the % coverage of SAV indicate that the downstream mangrove transition zone has, in the initial stages of the C-111SCWP project, experienced a significantly longer hydro-period and lower salinity levels in 2012-13 than in the comparison year, 2008-09. Due to these results, it was hypothesized that there would be a shift in the community structure of prey base fish towards a population with more freshwater species. In addition, it would be expected that fish density and biomass levels would increase in 2012-13 as it has been shown that both density and biomass will progressively increase as salinity levels decrease (Lorenz and Serafy, 2006).

Results of analyses on prey base fish indicated that 2012-13 did not experience the expected higher density and biomass values; however, there was a noted shift in the community structure. As expected with an increase in freshwater flow in Taylor Slough, possibly due to the C-111SCWP, there was an increase in the percentage of freshwater species in the Taylor Slough watershed. The lengthened hydro-period may have resulted in the greatest percentage of freshwater species to be found in February, prior to the salinity increase at the end of the dry season. It has been documented that longer time periods with low salinities would result in changes in fish community structure to incorporate more fish species with a salinity affinity for freshwater (Lorenz and Serafy, 2006). Additionally, even though Mayan cichlids have been found to have a salinity affinity for oligohaline waters, it has been cited that they also benefit greatly from an increase in the duration of time in which water have low salinities (Faunce et al., 2004). This appears to be the case as the freshwater period was extended by 5 months in TS in 2012-13, and the percentage of freshwater species increased by 5.8% and the percentage of Mayan cichlids increased by 8.0% in 2012-13 in comparison to 2008-09.

In contrast to Taylor Slough, sites in the C-111 watershed showed higher salinities and an increase in species with a salinity affinity for more saline waters in 2012-13 when compared to 2008-09. However, when the three sites found in the C-111 were examined individually, it was found that the increase in mesohaline species in the C-111 watershed was attributed to an increase of mesohaline species at both the Sunday Bay and Highway Creek sites. Occurring at the same time was a decrease in the percentage of oligohaline species along with an absence of any freshwater species at both Sunday Bay and Highway Creek in 2012-13. Conversely, Joe Bay actually showed a decrease in mesohaline species and an increase in freshwater species in 2012-13 compared to 2008-09 (Figure 63). The increase in the amount of mesohaline species found at Sunday Bay and Highway Creek could possibly be attributed to the overall increase in salinity levels at these two sites which conceivably resulted from the construction of a bridge at Manatee Creek and new culverts under US-1 in the adjacent wetlands near the Monroe/Miami-Dade county line during the reconstruction and widening of US1 (Frezza et al., 2011). This project was completed in January 2008, and has caused an increase in the amount of tidal waters and wind driven flow from the Atlantic Ocean into Long Sound via southern Biscayne Bay. Distance and the land barrier between Long Sound and Joe Bay could prevent the Joe Bay site from being influenced by Atlantic Ocean tides resulting from the newly constructed bridge and culverts. At the HC and SB sites, the length of time in which salinities were at oligohaline levels or lower only lasted 4 months during 2012-13 compared to an 8 month duration at Joe Bay (Figures 42-44). Additionally, the decrease in the salinity levels and increase in freshwater fish species at Joe Bay could be a result of the C-111SCWP. The duration of low salinity levels at Joe Bay was similar to that of Taylor River, East Creek, and West Joe Bay, lasting from June into February during 2012-13 (Figure 39-42). Salinity levels started to increase first at Joe Bay then continued from east to west. This seemed to correspond with the die off of *Ruppia* from east to west and an increase of freshwater prey base fish species. Although it was not anticipated that Joe Bay would be affected by the additional freshwater flow from the C-111SCWP, it may be a contributing factor to the more freshwater conditions found there during 2012-13. We will continue to monitor conditions at Joe Bay and the Taylor Slough sites to compare any further similarities as a result of the C-111SCWP.

The Southern Biscayne Bay watershed was similar to Taylor Slough in that there was an overall decrease in salinity levels and an increase in percent coverage of SAV in 2012-13, compared to 2008-09. The fish community may have reflected these changes with an increase in the percentage of mesohaline prey base fish species and a decrease in percentage of polyhaline species in Southern Biscayne Bay. This could be attributed to the Card Sound Canal Restoration Project which was designed to lower salinity levels in the surrounding wetlands, which could possibly contribute to lowering salinity levels, increasing SAV, and shifting the fish community structure at the sites found in Southern Biscayne Bay. The Card Sound Canal Restoration Project was discussed in depth in the hydrology section of this report on pages 19&20.

Although there appeared to be a shift in the community structure as hypothesized, the density, biomass, available density and available biomass did not respond as anticipated. The density and biomass levels, as well as the available density and available biomass levels were greater in 2008-09 in nearly every comparison made between years. This could have been an outcome of the lower water levels found in 2008-09 during the dry season. As discussed in the hydrology section, the annual water levels were higher in all three watersheds during 2012-13, especially during the dry season when the 6 month mean dry season water level exceeded 2008-09 by 12.7 cm in TS, 11.9 cm in C-111, and 10.9 cm in SBB (Figure 22). This could have had a significant impact on the prey base fish community. The higher water levels could have prevented the concentration events that occur when the water level drops and the flats become dry, forcing fish into the refuge provided by deeper creeks. It has been documented that the prey concentration threshold (PCT) where prey base fish start to become concentrated occurs at a water level of 13cm (Lorenz, 2013b). Above average water levels that were found in Taylor Slough in 2012-13 barely dipped below 13cm; however water levels at all three prey base fish sites in Taylor Slough were at or below 13cm for the majority of the dry season in 2008-09. Although the sites found in the C-111 had water levels that were below 13cm more often than the sites in Taylor Slough, it was only for brief stints of time before climbing back up above the 13cm mark, unlike 2008-09 where water levels were below 13cm for months at a time. Barnes Sound, the only site in Southern Biscayne Bay to have water levels drop below 13cm, only recorded a total of 14 days with water levels below 13cm during the entire 2012-13 dry season. It becomes even more so apparent why density and biomass levels were lower in 2012-13 as there were only 4 fish samples during 2012-13 collected below 13cm compared to the 32 samples collected in 2008-09 at water levels below 13cm. Additionally, water levels never reached 0cm or below at any of the nine prey base fish sites during 2012-13, and the only site to reach a water level below 5cm was HC.

Water levels being below the initial PCT level of 13cm for brief time periods, often only for a day or two at a time, may have prevented fish from congregating at that water level, and could have prevented concentrations at lower water levels as well. As the flats become more dry it can create thresholds of concentrations of fish, especially as water levels near 0cm and force all remaining fish into the deep creeks (Lorenz, 2013b). The lower water levels in 2008-09 could have allowed the fish to aggregate into deeper areas creating the higher density, biomass, available density and available biomass values found in 2008-09.

The greatest difference between years in the stratified density and biomass can be attributed to one sample as the *post hoc* revealed that there was only a significant difference during the month of December. When the data were examined even further and separated by individual sites, it showed that the only site where there was a significant difference between years was CS (Figure 64) during the month of December (Figure 48). The December 2008 sample at CS was collected after an acute drop in water level of 25cm in 12 days (Figure 59). The water levels decreased at BS and MB in SBB at the same time during December 2008, but they did not drop as drastically as at CS. The water level only dropped 13cm at BS and 19cm at MB. Although the water level at CS only dropped to 27cm at the time of the December 08 sample, the rapid decrease in water level could have triggered a concentration event, as Kahl (1964) considered the PCT to be at 10cm and indicated that even a 6cm water level drop could cause a fish concentration at wood stork monitoring sites in the Corkscrew Swamp Sanctuary. The PCT of 13cm discussed earlier was determined for the prey base fish sites in TS and C-111 (Lorenz, 2013b). In addition, the PCT has not been documented in the SBB watershed where the sites are influenced by semi-diurnal tides and in general have higher water levels than the sites found in the other two watersheds.

The initial response in the community structure possibly due to the lower salinity levels for a longer duration of time feasibly shows the success of the C-111SCWP. The community structure which generally is determined by the hydrology of the 60 days prior to a sample (Lorenz and Serafy, 2006), seemed to greatly benefit from the extended period of lower salinities in 2012-13. Although the density, biomass, available density and available biomass did not show support for this project's success in 2012-13, it could show support in future years with lower water levels and as the fish populations further adapt to a freshwater community which could take up to 3 years to reach the pre-drainage conditions of the Everglades (Lorenz and Serafy, 2006).

Spoonbill Nesting Success and Prey Availability

Spoonbill nests were monitored in northeastern Florida Bay in 2008-09 (63 total nests) and in 2012-13 (188 total nests). The average number of chicks that survived until 21d post-hatch (when the birds leave the nest and can no longer be monitored) was 1.77 chicks/nest attempt (c/n) in 2008-09 and 1.29 c/n in 2012-13. The nestling period (period from when the first egg hatches to the last nest has chicks at 21d post-hatch) was the months of December through February in 2008-09 and late February through April in 2012-13.

The density and biomass of fish available to spoonbills are presented in Figures 51-59. Lorenz (2013b) demonstrated that available density is a better indicator of the food availability for spoonbills than available biomass. Although counter-intuitive, available biomass is not as good a measure of fish concentrations and what is available to a foraging spoonbill (see Lorenz 2013b for a full reasoning of this). In December 2008, the highest available fish density recorded for all sites for that year was at CS (Figure 59) and relatively high density was recorded from both TR (Figure 51) and HC (Figure 56). In January 2009 there was relatively high available density at SB (Figure 55), MB (Figure 57) and CS (Figure 59) and extremely high densities at JB (Figure 54). In February 2009, available density was very high at CS (Figure 59) and moderately high at MB (Figure 57) and WJ (Figure 53). The high degree of available fish across a broad spatial scale, especially during the earliest stages of chick development when their energetic demand is extremely high, likely explains the high degree of nesting success in the 2008-09 nesting season. In March 2013 fish availability was low at all sites, however, modest availability occurred at TR (Figure 51) EC (Figure 52) and JB (Figure 54). Perhaps the centrality of these 3 sites made foraging easier for nesting spoonbills so the relatively low concentrations of fish may have been offset by flight time to the foraging grounds, i.e., shorter travel may result in longer foraging time. In April 2013, highest densities for the year were recorded at JB, SB and HC (Figures 54-56) thereby providing adequate foraging resources later in the chick's development.

Spoonbill Discussion. Between 1982-83 and 2004-05, spoonbills averaged 1 c/n or more in only 7 of the 20 years that nests were monitored. The success rate of 1.29 c/n in 2012-13 marks the sixth time in the last seven years that spoonbills produced >1c/n. This change coincides with increased communication between the operations team at the South Florida Water Management District and Audubon scientists. This year also marks the second consecutive year with an increase in nest number over the previous suggesting that the chicks produced over the last seven years are entering the breeding population.

The goal of the communication between the District and Audubon is to reduce the incidence and magnitude of any operations that would result in water level reversals thereby dispersing the spoonbill's prey. Lorenz (2013b) demonstrated that this happens when water levels are above 13 cm relative depth on the flats habitat. During the nestling period of 2008-09, water levels were below the 13 cm mark at all of the sites within the Taylor Slough and C-111 watersheds (Figures 51-56) but not in the Southern Biscayne Bay watershed (Figures 57-59) thereby providing concentrations of fish to nesting spoonbills. During the nesting period of 2012-13, water levels fluctuated around 13 cm at all sites in the Taylor Slough and C-111 watersheds (Figure 51-56) but remained well above 13 cm at the Southern Biscayne Bay watershed. The temporal fluctuations at the Taylor Slough and C-111 sites must have been such that they were spatially out of synch with each other such that there were adequate foraging conditions at one location or another throughout the breeding season such that spoonbills were able to find adequate food resources for them to successfully raise their chicks.

Conclusions

- We were unable to control for antecedent conditions because the previous hydrologic year (2011-12) was very different in rainfall patterns for any other year in our database. This adds some uncertainty to our remaining conclusions but based on the similarity in rainfall patterns between 2008-09 and 2012-13, we feel the following has merit.
- Flow rates appeared to have been strongly influenced by the operation of the C-111SCWP project with greater flows at Taylor Slough Bridge, the lowest ratio of C-111 discharge to Taylor Slough flow for our period of record and a greatly reduced ratio of inflows to the C-111 canal from S-331 to discharges further down stream at S-177. These findings indicate the project is accomplishing the goal of reducing seepage from Taylor Slough into the lower C-111. This would suggest greater freshwater flow into Florida Bay via Taylor Slough.
- Comparing 2012-13 results to 2008-09 was justified based on the similarity in rainfall patterns. Salinity at our sampling sites in Taylor Slough, and to lesser degree in the C-111 basin were significantly lower than post-project (2012-13) than prior to it (2008-09). At our project control sites in Southern Biscayne Bay, salinity was also lower but the difference between years did not appear to be ecologically significant. Although not conclusively demonstrated, it appears that difference in Taylor Slough and C-111 basins were the result of project operations while those in Southern Biscayne Bay were the result of differing antecedent conditions prior to the two comparison years.
- Water levels were significantly higher in all three watersheds in 2012-13 than in 2008-09. This could be a project result but sea level rise is likely playing a role in this as well. During the dry season, water levels in Taylor Slough and the C-111 basin were consistently below the prey concentration threshold of 13 cm relative depth in 2008-09 but fluctuated above and below this threshold in 2012-13. Water levels below this point are vital to spoonbills during their nesting season such that prey fish are concentrated sufficiently to allow for ease of capture.
- Lower salinity, higher water levels and longer hydroperiods have been linked to greater SAV production and this was born out in our comparison years. In both Taylor Slough and the C-111 basins, SAV was much more abundant in 2012-13 than in 2008-09. There are many other factors that play into the abundance of SAV, so this can not be conclusively linked to project operations, however, the CEM predicted this result if the project were successful in lowering salinity and increasing hydroperiods, i.e., we can not establish a causal relation between operations and greater SAV abundance but there is a strong correlation that was predicted in advance.
- The abundance of prey fish was also predicted to be higher under the 2012-13 hydrologic conditions but, in fact, fish were consistently more abundant in 2008-09. Passed findings, however, indicate that this response has about a three-year lag time for fish to respond to lower salinities. This is because a fish community dominated by freshwater species takes some time to immigrate into the estuarine habitat and become established. There was a greater abundance of freshwater species at the Taylor Slough sites which was encouraging, but the percentage of these species were well below the desired target of >50% freshwater species.
- Availability of fish to spoonbills were much more consistent with successful nesting in 2008-09 than in 2012-13. This was likely due to higher water levels during the nesting

cycle during 2012-13 which likely resulted in less fish concentration events. Both years, however, resulted in successful nesting attempts by spoonbills in northeaster Florida Bay. Clearly, conditions were satisfactory for foraging spoonbills on the feeding grounds in 2012-13. Our monthly sampling events may simply have missed peak concentration events.

Although these findings are quite promising for the success of the C-111SCWP project, caution must be used in declaring that the ecological observation made were a direct result of the project. There is much serendipity in the ecosystem and a single year post project is not sufficient to make such claims. For example, the fact that we could not control for antecedent conditions may have played a large role. With that said, however, the responses in the physical environment and the ecosystem were consistent with predictions that were made prior to the project coming online.

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Table 1. Rainfall gauges used for analyses and the corresponding collecting agency.

Station Name	Collecting Agency
Canal Point	NOAA National Climatic Data Center
Devils Garden	NOAA National Climatic Data Center
Everglades	NOAA National Climatic Data Center
Ft. Lauderdale	NOAA National Climatic Data Center
Ft. Myers	NOAA National Climatic Data Center
Hialeah	NOAA National Climatic Data Center
La Belle	NOAA National Climatic Data Center
Loxahatchee	NOAA National Climatic Data Center
Miami Int	NOAA National Climatic Data Center
Moore Haven	NOAA National Climatic Data Center
Naples	NOAA National Climatic Data Center
Oasis	NOAA National Climatic Data Center
Punta Gorda	NOAA National Climatic Data Center
Stuart	NOAA National Climatic Data Center
West Palm Beach	NOAA National Climatic Data Center
Homestead Gen	**NOAA National Climatic Data Center**
Perrine	**NOAA National Climatic Data Center**
Royal Palm RS	**NOAA National Climatic Data Center**
MD	**SFWMD**
JB	**SFWMD**
TC	**Everglades National Park**
HC	**Everglades National Park**
LS	**Everglades National Park**
DK	**Everglades National Park**
BN	**Everglades National Park**
LM	**Everglades National Park**
TR	**Everglades National Park**
CP	**Everglades National Park**
EPSW	**Everglades National Park**
EVER8	**Everglades National Park**
R127	**Everglades National Park**
R3110	**Everglades National Park**
NTS10	**Everglades National Park**
ROBBLEE	**Everglades National Park**
IFS	**Everglades National Park**
P38	**Everglades National Park**
P35	**Everglades National Park**
P36	**Everglades National Park**
P37	**Everglades National Park**
FMB	**Everglades National Park**
NP201	**Everglades National Park**
NP203	**Everglades National Park**
NP206	**Everglades National Park**
NP202	**Everglades National Park**
P33	**Everglades National Park**
P34	Everglades National Park
BR	Everglades National Park
OT	Everglades National Park
NR	Everglades National Park
NP205	Everglades National Park

*Stations in bold denote those used in Local Rainfall analysis

Table 2. Locations of Submerged Aquatic Vegetation Sub-sites. Coordinate marks beginning of transect.

Site: Barnes Sound

Sub-Site	**Lat/Long (WGS 84)**
BS1	25º17.635 N 80º24.071 W
BS2	25º17.566 N 80º23.827 W
BS3	25º17.443 N 80º23.585 W
BS4	25º17.377 N 80º23.445 W

Site: Manatee Bay

Sub-Site	
MB1	25º16.398 N 80º25.448 W
MB2	25º16.098 N 80º25.302 W
MB3	25º15.769 N 80º25.287 W
MB4	25º15.728 N 80º23.993 W

Site: Card Sound

Sub-Site	
CS1	25º18.771 N 80º22.752 W
CS2	25º18.373 N 80º22.604 W

Site: Highway Creek

Sub-Site	
HC1	25º15.131 N 80º27.545 W
HC1A	25º15.104 N 80º27.452 W
HC2	25º15.072 N 80º27.401 W
HC3	25º15.162 N 80º27.056 W
HC4A	25º15.192 N 80º26.853 W
HC5	25º14.807 N 80º26.620 W
HC6	25º14.614 N 80º26.576 W

Site: Joe Bay

Sub-Site	
JB1	25º14.675 N 80º31.921 W
JB2	25º14.431 N 80º32.057 W
JB3	25º14.273 N 80º31.909 W
JB4	25º13.353 N 80º31.898 W
JB5	25º13.007 N 80º32.008 W
JB6	25º12.795 N 80º32.027 W
DJ	25º13.029 N 80º33.322 W

Site: Sunday Bay

Sub-Site	**Lat/Long (WGS 84)**
SB1	25º14.414 N 80º29.188 W
SB2	25º14.306 N 80º28.945 W
SB3	25º13.966 N 80º29.029 W

Site: Taylor River

Sub-Site	
TR1	25º13.227 N 80º38.968 W
TR2	25º12.962 N 80º39.011 W
TR3	25º12.455 N 80º38.716 W
TR4A	25º12.132 N 80º38.574 W
TR5	25º11.736 N 80º38.277 W
TR6	25º11.329 N 80º38.395 W
DT	25º11.894 N 80º38.510 W

Site: East Creek

Sub-Site	
EC1	25º12.980 N 80º37.906 W
EC2	25º12.841 N 80º37.786 W
EC3	25º12.483 N 80º37.271 W

Site: West Joe Bay

Sub-Site	
WJ1	25º14.503 N 80º34.544 W
WJ2	25º14.335 N 80º34.622 W

Table 3. Summary of SAV surveys conducted at Taylor River (TR 1) for report period (2012-13) and comparison year, 2008-09. All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Utricularia spp., Chara hornemanii, Najas marina, Ruppia maritima, Batophora oerstedii, Cladophora sp.,* and *Nitella sp.*

TR1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*	*Nit sp.*
3-Jun-08	35.9	44.0	bottom	30.0		2.67	0.00	0.83	0.00	1.33	1.83	0.00	0.00
15-Jul-08	27.5	60.0	bottom	29.8		2.00	0.00	0.50	0.00	0.67	1.67	0.00	0.00
18-Sep-08	4.9	92.0	bottom	30.2		4.17	0.00	2.67	0.00	0.17	2.67	0.00	0.00
16-Oct-08	1.3	83.0	bottom	26.6		24.17	0.00	21.83	0.17	2.33	1.33	0.00	0.00
6-Dec-08	1.4	61.0	bottom	21.5		32.50	0.00	32.50	0.00	0.17	0.67	0.00	0.00
13-Jan-09	0.9	60.0	bottom	24.0		16.83	0.00	16.50	0.17	0.67	0.33	0.00	0.00
4-Mar-09	5.1	42.0	bottom	21.5		8.17	0.00	6.83	0.00	1.67	0.83	0.00	0.00
15-Apr-09	32.3	68.0	bottom	27.5		9.33	0.00	3.67	0.00	4.50	2.00	0.67	0.00
2-Jun-09	31.8	88.0	85.0	28.3		5.83	0.00	2.00	0.00	0.33	3.50	0.00	0.00
19-Jul-12	0.3	102.0	bottom	30.5	36.3	53.00	0.00	19.83	2.00	7.83	34.67	3.17	0.83
19-Sep-12	0.4	103.0	bottom	31.6	24.0	58.00	1.00	22.00	6.00	3.67	35.50	0.00	0.83
14-Nov-12	0.4	91.0	bottom	25.0	30.0	64.33	0.00	16.33	0.83	4.33	56.17	0.00	1.67
24-Jan-13	0.5	82.0	bottom	20.7	21.7	59.83	0.33	14.00	0.33	1.67	46.50	0.00	0.83
20-Mar-13	14.7	78.0	bottom	26.8	54.7	28.50	0.33	4.50	0.17	1.00	25.50	0.00	0.17
15-May-13	11.9	89.0	bottom	30.1	28.3	23.33	0.17	4.33	0.00	1.50	19.83	0.00	0.00

Table 4. Summary of SAV surveys conducted at Joe Bay (JB 1) for report period (2012-13) and comparison year, 2008-09. All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Utricularia spp., Chara hornemanii, Najas marina, Ruppia maritima, Batophora oerstedii, Cladophora sp.*

JB1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*
2-Jun-08	41.6	52.0	bottom	30.7		7.00	0.00	0.00	0.00	6.00	1.33	0.00
14-Jul-08	2.1	60.0	bottom	26.9		7.00	0.00	0.00	0.50	3.83	4.17	0.00
17-Sep-08	0.7	80.0	bottom	29.8		1.33	0.00	0.00	0.33	0.50	0.67	0.00
17-Oct-08	0.4	62.0	bottom	26.3		1.33	0.00	0.83	0.00	0.50	0.83	0.00
5-Dec-08	0.7	55.0	bottom	20.9		5.33	0.00	3.00	1.50	0.50	1.33	0.00
12-Jan-09	1.1	40.0	bottom	21.5		10.00	1.33	2.83	4.00	2.33	0.67	0.00
3-Mar-09	23.1	38.0	bottom	18.7		0.67	0.00	0.17	0.00	0.00	0.17	0.33
17-Apr-09	40.7	41.0	bottom	25.6		11.00	0.00	0.00	0.00	0.00	4.00	9.33
1-Jun-09	27.5	78.0	bottom	33.1		12.50	0.00	0.00	0.00	0.00	8.17	7.50
18-Jul-12	0.3	61.0	bottom	28.5	78.7	18.83	1.33	9.67	2.83	2.33	4.50	1.33
17-Sep-12	0.3	60.0	bottom	28.1	88.0	45.00	33.00	9.00	1.83	4.33	2.83	0.00
31-Oct-12	4.7	88.0	bottom	22.6	56.0	45.33	38.33	5.00	2.17	5.00	1.50	0.00
28-Jan-13	2.0	41.0	bottom	24.9	66.7	21.17	14.33	2.17	1.50	3.00	3.50	0.17
27-Mar-13	18.3	43.0	bottom	17.4	79.7	15.17	0.00	0.00	0.00	2.17	3.83	13.00
14-May-13	21.0	50.0	bottom	28.1	74.3	35.83	0.00	0.00	0.00	8.00	1.33	28.67

Table 5. Summary of SAV surveys conducted at Highway Creek (HC 1A) for report period (2012-13) and comparison year, 2008-09. All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Utricularia spp, Chara hornemanii*, *Najas marina*, *Ruppia maritima*, *Batophora oerstedii*, *Cladophora sp.*

HC1A Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*
6-Jun-08	44.3	48.0	bottom	28.6		3.67	0.00	1.00	0.00	1.67	1.83	0.00
16-Jul-08	1.7	65.0	bottom	26.7		6.00	0.00	2.50	0.00	0.50	3.50	1.67
5-Sep-08	3.3	86.0	bottom	27.8		3.33	0.00	1.17	0.00	0.83	2.17	0.83
15-Oct-08	1.2	80.0	bottom	25.2		12.33	0.00	5.50	0.00	2.67	5.67	0.83
3-Dec-08	1.4	58.0	bottom	18.4		18.17	0.00	6.33	0.00	12.67	2.33	0.33
28-Jan-09	12.1	33.0	bottom	23.0		4.17	0.17	0.67	0.00	2.33	1.83	0.00
2-Mar-09	26.8	35.0	bottom	18.1		5.33	0.00	0.00	0.00	4.33	1.17	0.00
13-Apr-09	38.0	40.0	bottom	26.7		3.50	0.00	1.33	0.00	1.17	1.17	0.00
3-Jun-09	1.9	71.0	bottom	27.1		16.83	0.00	5.33	0.00	7.50	3.67	0.50
16-Jul-12	0.3	57.0	bottom	28.8	103.0	72.00	3.00	62.17	20.00	1.33	0.00	5.33
10-Sep-12	0.5	51.0	bottom	29.0	109.3	83.33	26.67	71.00	4.50	1.50	0.00	0.00
2-Nov-12	13.9	79.0	bottom	26.0	106.3	63.67	5.00	48.33	10.67	6.17	0.00	0.00
21-Jan-13	11.2	24.0	bottom	23.6	135.3	47.00	0.33	38.50	4.17	6.00	3.67	0.00
31-Mar-13	19.2	46.0	bottom	26.1	102.0	23.67	0.00	3.00	3.00	10.33	14.33	0.00
8-May-13	19.1	53.0	bottom	25.2	102.7	37.83	0.00	22.50	3.50	5.83	11.67	0.00

Table 6. Summary of SAV surveys conducted at Barnes Sound (BS 1) for report period (2012-13) and comparison year, 2008-09. All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Chara hornemanii*, *Ruppia maritima*, *Batophora oerstedii*, *Halodule wrightii*, and *Polysiphonia sp.*

.

BS1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Cha hor*	*Rup mar*	*Bat sp.*	*Hal wri*	*Pol sp.*
11-Jun-08	38.0	38.0	bottom	28.7		27.00	0.00	4.17	0.00	25.67	0.00
17-Jul-08	11.2	38.0	bottom	28.5		26.83	0.00	0.67	0.00	26.50	0.00
3-Sep-08	29.5	68.0	bottom	28.3		22.00	0.00	0.00	0.00	22.00	0.00
14-Oct-08	22.2	40.3	bottom	26.6		24.00	0.00	6.67	0.17	19.33	0.00
4-Dec-08	8.5	32.0	bottom	17.8		13.00	0.00	0.67	0.33	13.00	0.00
26-Jan-09	31.0	13.0	bottom	18.1		17.67	0.00	0.33	0.00	17.67	0.00
9-Mar-09	41.2	30.0	bottom	22.3		42.00	0.00	15.17	0.33	33.00	0.17
5-May-09	43.2	42.0	bottom	27.5		70.33	0.00	41.00	0.50	49.00	0.17
2-Jun-09	9.6	45.0	bottom	30.0		65.33	0.00	12.33	1.67	60.00	0.17
17-Jul-12	0.6	47.0	bottom	28.5	154.0	93.67	1.67	31.67	6.83	78.67	0.00
5-Sep-12	0.9	40.0	bottom	31.5	131.3	96.67	17.17	35.67	4.17	62.33	0.00
30-Oct-12	25.8	83.0	bottom	20.0	132.7	82.00	30.67	44.33	17.00	10.00	0.00
4-Jan-13	17.6	32.0	bottom	25.6	128.7	76.00	45.00	38.50	9.67	1.17	0.00
4-Mar-13	33.2	34.0	bottom	20.4	136.3	87.33	43.00	47.50	8.17	2.50	4.00
17-May-13	29.5	40.0	bottom	30.6	128.0	85.33	43.00	25.00	33.83	1.83	6.50

Table 7. Summary of SAV surveys conducted at Manatee Bay (MB 1) for report period (2012-13) and comparison year, 2008-09. All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Halodule wrightii*, *Thalassia testudinum*, *Batophora oerstedii*, *Polysiphonia sp.*, *Chara hornemanii*, and *Acetabularia sp.*

MB1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	Total	*Hal wri*	*Tha tes*	*Bat sp.*	*Pol sp.*	*Cha hor*	*Ace sp.*
5-Jun-08	38.6	40.0	bottom	28.8		6.17	5.83	0.00	0.83	0.00	0.00	0.00
18-Jul-08	6.6	49.0	bottom	30.7		5.17	5.17	0.00	0.17	0.00	0.00	0.00
4-Sep-08	22.5	75.0	bottom	28.8		5.00	5.00	0.00	0.00	0.00	0.00	0.00
20-Oct-08	19.8	69.0	bottom	26.6		2.33	2.33	0.00	0.00	0.00	0.00	0.00
30-Nov-08	7.7	45.0	bottom	22.4		4.33	4.33	0.00	0.00	0.00	0.00	0.00
27-Jan-09	26.9	32.0	bottom	21.6		3.67	3.67	0.00	0.00	0.00	0.00	0.00
6-Mar-09	32.5	55.0	bottom	18.7		5.50	5.50	0.00	0.00	0.00	0.00	0.00
16-Apr-09	43.0	32.0	bottom	29.1		6.50	6.17	0.33	0.00	0.00	0.00	0.00
5-Jun-09	6.8	55.0	bottom	27.8		4.33	4.33	0.00	0.00	0.67	0.00	0.00
9-Jul-12	7.0	58.0	bottom	28.2	103.3	2.50	2.50	0.00	0.83	0.00	0.00	0.00
4-Sep-12	2.0	60.0	bottom	29.8	108.0	4.67	2.83	0.00	0.67	0.00	2.83	0.00
29-Oct-12	21.8	102.0	bottom	22.0	119.7	2.50	2.50	0.17	0.83	0.00	0.67	0.00
11-Jan-13	22.6	51.0	bottom	22.1	113.7	3.67	3.67	0.00	0.17	0.00	0.00	0.00
5-Mar-13	29.5	54.0	bottom	18.9	105.0	4.83	4.83	0.00	0.00	0.00	0.00	0.00
20-May-13	30.4	54.0	bottom	27.8	112.7	4.67	4.67	0.00	1.00	0.50	0.00	0.17

Table 8. All sample dates for BS, CS, MB, HC, JB, SB, EC, TR and WJ for the 2 hydrologic years, 2008-09 and 2012-13. Asterisk(*) indicates that both the creek and flats nets were completely dry on the date that the site was sampled. NS indicates that a sample was Not Sampled during that month.

SAMPLE	WATERSHED								
	SBB			C-111			TS		
2008-2009	**BS**	**CS**	**MB**	**HC**	**JB**	**SB**	**EC**	**TR**	**WJ**
Jun-08	6/4/2008	6/3/2008	6/4/2008	6/11/2008	6/12/2008	6/23/2008	6/25/2008	6/25/2008	6/12/2008
Sep-08	9/19/2008	10/20/2008	10/21/2008	9/20/2008	9/13/2008	9/16/2008	9/12/2008	9/16/2008	9/13/2008
Nov-08	11/4/2008	11/3/2008	11/5/2008	11/13/2008	11/11/2008	11/7/2008	11/10/2008	11/13/2008	11/11/2008
Dec-08	12/2/2008	12/4/2008	12/1/2008	12/9/2008	12/9/2008	12/5/2008	12/9/2008	12/4/2008	NS
Jan-09	1/11/2009	1/6/2009	1/8/2009	1/12/2009*	1/14/2009	1/26/2009	1/15/2009	1/15/2009	1/16/2009
Feb-09	2/3/2009	2/7/2009	2/12/2009	2/17/2009	2/11/2009	2/13/2009	2/10/2009	2/10/2009	2/13/2009
Mar-09	3/5/2009	3/5/2009	3/5/2009	3/18/2009	3/10/2009	3/10/2009	3/10/2009	3/13/2009	3/11/2009*
Apr-09	4/1/2009	4/1/2009	4/1/2009	4/9/2009	4/15/2009	4/15/2009	4/10/2009	4/7/2009	4/15/2009
2012-2013									
Jun-12	5/31/2012	5/30/2012	5/30/2012	6/12/2012	6/6/2012	6/7/2012	6/13/2012	6/13/2012	6/6/2012
Sep-12	9/5/2012	9/5/2012	9/5/2012	9/19/2012	9/14/2012	9/13/2012	9/20/2012	9/20/2012	9/13/2012
Nov-12	11/13/2012	11/8/2012	11/8/2012	11/7/2012	11/5/2012	11/16/2012	11/15/2012	11/15/2012	11/2/2012
Dec-12	11/29/2012	11/28/2012	11/28/2012	12/6/2012	12/5/2012	12/25/2012	12/12/2012	12/12/2012	12/10/2012
Jan-13	1/3/2013	1/9/2013	1/10/2013	1/16/2013	1/16/2013	1/23/2013	1/23/2013	1/23/2013	1/15/2013
Feb-13	2/7/2013	2/6/2013	2/6/2013	2/12/2013	2/13/2013	2/20/2013	2/20/2013	2/20/2013	2/13/2013
Mar-13	3/6/2013	3/4/2013	3/6/2013	3/12/2013	3/11/2013	3/21/2013	3/21/2013	3/21/2013	3/10/2013
Apr-13	4/4/2013	4/4/2013	4/4/2013	4/10/2013	4/9/2013	4/16/2013	4/17/2013	4/18/2013	4/10/2013

Table 9. Phylogenetic list of all species sampled and the percent catch for each month during 2012-13 for the TS Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

Taylor Slough Watershed 2012-13												
ORDER	**Family**	***Genus Species***	**Common Name**	**Jun**	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
ATHERINIFORMES	Atherinidae	*Menidia peninsulae*	Tidewater Silverside	0.91%	0.59%					1.83%	3.45%	**0.89%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	10.03%	3.54%	2.78%	5.60%		0.41%	3.21%	3.45%	**5.08%**
	Fundulidae	*Floridichthys carpio*	Goldspotted Killifish	1.55%							0.31%	**0.48%**
		Fundulus chrysotus	Golden Topminnow			0.28%	0.29%	0.81%	0.41%	1.38%	0.94%	**0.38%**
		Fundulus confluentus	Marsh Killifish	1.09%	0.15%							**0.35%**
		Fundulus grandis	Gulf Killifish		0.15%	0.28%						**0.05%**
		Lucania goodeii	Bluefin Killifish				1.47%	8.50%	4.49%	7.80%	3.76%	**2.23%**
		Lucania parva	Rainwater Killifish	46.03%	68.73%	77.50%	63.13%	51.01%	39.18%	46.10%	55.17%	**55.44%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish	0.91%	0.74%	0.28%	1.18%	0.40%	1.22%	0.92%		**0.75%**
		Gambusia affinis	Mosquitofish	1.73%	0.59%	0.56%			0.41%	4.82%	2.19%	**1.45%**
		Poecilia latipinna	Sailfin Molly	3.74%	1.18%		2.65%	8.10%	2.45%	2.06%	4.39%	**2.88%**
PERCIFORMES	Centrarchidae	*Lepomis spp.*	Sunfish spp.					0.40%				**0.03%**
		Lepomis gulosus	Warmouth						0.41%			**0.03%**
		Lepomis marginatus	Dollar Sunfish			0.28%	0.59%	1.21%	2.04%			**0.30%**
		Lepomis microlophus	Redear Sunfish				0.59%		0.41%			**0.08%**
		Lepomis punctatus	Spotted Sunfish				3.54%	9.72%	17.96%	5.73%	0.94%	**2.90%**
	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid	1.91%	10.62%	12.50%	15.04%	16.19%	26.53%	20.64%	11.91%	**11.34%**
		Hemichromis bimaculatus	Jewelfish		0.29%	1.67%		1.21%	0.82%	2.06%	2.19%	**0.78%**
		Tilapia mariae	Spotted Tilapia		0.15%							**0.03%**
	Gerridae	*Gerridae spp.*	Mojarra spp.		0.15%	0.56%		0.40%		0.23%		**0.13%**
	Gobiidae	*Microgobius gulosus*	Clown Goby	32.09%	13.13%	3.33%	5.90%	2.02%	2.45%	2.98%	11.29%	**14.32%**
	Lutjanidae	*Lutjanus griseus*	Gray Snapper							0.23%		**0.03%**
SYNBRANCHIFORMES	Synbranchidae	*Monopterus albus*	Asian Swamp Eel						0.82%			**0.05%**
			Totals									
			Number of Fish	1097	678	360	339	247	245	436	319	**3721**
			Number of Species	10	13	11	11	12	15	14	12	**23**
			Number of Nets Sampled	18	18	17	18	18	18	17	18	**142**

Table 10. Percent catch for all fish collected during each monthly sample in TS throughout 2012-13, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

Taylor Slough Watershed 2012-13									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater		0.15%	0.56%	6.49%	20.65%	26.53%	14.91%	5.64%	**6.02%**
Oligohaline	65.45%	85.84%	95.28%	87.61%	76.92%	71.02%	79.82%	79.31%	**78.07%**
Mesohaline	33.00%	13.86%	3.61%	5.90%	2.02%	2.45%	4.82%	14.73%	**15.26%**
Polyhaline	1.55%	0.15%	0.56%		0.40%		0.23%	0.31%	**0.62%**
Euhaline							0.23%		**0.03%**
Unknown									
Totals									
Number of Fish	1097	678	360	339	247	245	436	319	**3721**
Number of Salinity Classes	3	4	4	3	4	3	5	4	**5**
Number of Species	10	13	11	11	12	15	14	12	**23**
Number of Nets Sampled	18	18	17	18	18	18	17	18	**142**

Table 11. Phylogenetic list of all species sampled and the percent catch for each month during 2008-09 for the TS Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

Taylor Slough Watershed 2008-09

ORDER	Family	*Genus Species*	Common Name	Jun	Sep	Nov	Dec	Jan	Feb	Mar	Apr	HY Total
ANGUILLIFORMES	Anguillidae	*Anguilla rostrata*	American Eel					0.24%				**0.02%**
ATHERINIFORMES	Atherinidae	Menidia beryllina	Inland Silverside			0.14%						**0.02%**
		Menidia peninsulae	Tidewater Silverside		0.43%	0.41%	2.95%			8.59%	2.54%	**1.13%**
BATRACHOIDIFORMES	Batrachoididae	*Opsanus beta*	Gulf Toadfish						0.22%			**0.02%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	23.41%	24.09%	15.40%	16.22%	12.26%	10.04%	14.11%	17.77%	**18.62%**
	Fundulidae	*Adinia xenica*	Diamond Killifish						0.44%		0.51%	**0.06%**
		Floridichthys carpio	Goldspotted Killifish	15.73%	6.63%	3.00%	2.21%	13.68%	8.95%	3.37%	1.02%	**7.65%**
		Fundulus confluentus	Marsh Killifish	0.49%	0.57%		0.25%	2.59%	12.23%	0.92%	3.05%	**1.87%**
		Fundulus grandis	Gulf Killifish	0.49%	0.43%		0.25%	1.42%	1.75%	9.51%	5.08%	**1.38%**
		Lucania parva	Rainwater Killifish	39.88%	41.13%	42.64%	38.08%	26.89%	51.09%	38.65%	50.76%	**40.81%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish					0.71%				**0.06%**
		Gambusia affinis	Mosquitofish	0.24%	0.21%	0.27%	0.25%	0.71%	0.66%	4.29%	1.02%	**0.63%**
		Poecilia latipinna	Sailfin Molly	14.51%	6.77%	11.04%	15.23%	9.67%	6.77%	3.68%	4.57%	**9.44%**
PERCIFORMES	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid	0.49%	1.71%	6.40%	4.42%	14.15%	0.44%	1.23%		**3.33%**
		Tilapia mariae	Spotted Tilapia				1.72%					**0.15%**
	Gerridae	*Gerridae spp.*	Mojarra spp.		0.21%	0.54%	0.25%				1.02%	**0.21%**
	Gobiidae	*Gobiosoma bosci*	Naked Goby	0.12%								**0.02%**
		Lophogobius cyprinoides	Crested Goby	0.12%	4.13%	9.13%	9.58%	7.31%	1.31%	2.76%	3.05%	**4.55%**
		Microgobius gulosus	Clown Goby	4.51%	13.68%	11.04%	8.60%	10.38%	6.11%	12.88%	9.64%	**10.02%**
			Totals									
			Number of Fish	820	1403	734	407	424	458	326	197	**4769**
			Number of Species	11	12	11	13	12	12	11	12	**19**
			Number of Nets Sampled	16	18	18	12	16	9	12	17	**118**

Table 12. Percent catch for all fish collected during each monthly sample in the TS Watershed throughout 2008-09, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

Taylor Slough Watershed 2008-09									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater			0.14%	1.72%					**0.17%**
Oligohaline	79.27%	78.62%	84.88%	84.03%	74.53%	82.97%	65.64%	80.71%	**79.41%**
Mesohaline	5.00%	14.54%	11.44%	11.79%	11.79%	7.86%	30.98%	17.26%	**12.54%**
Polyhaline	15.73%	6.84%	3.54%	2.46%	13.68%	9.17%	3.37%	2.03%	**7.88%**
Euhaline									
Unknown									
Totals									
Number of Fish	820	1403	734	407	424	458	326	197	**4769**
Number of Salinity Classes	3	3	4	4	3	3	3	3	**4**
Number of Species	11	12	11	13	12	12	11	12	**19**
Number of Nets Sampled	16	18	18	12	16	9	12	17	**118**

Table 13. Phylogenetic list of all species sampled and the percent catch for each month during 2012-13 for the C-111 Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

C-111 Watershed 2012-13												
ORDER	**Family**	***Genus Species***	**Common Name**	**Jun**	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
ANURA		Anuran larvae	Tadpole	0.16%								**0.03%**
ATHERINIFORMES	Atherinidae	*Menidia peninsulae*	Tidewater Silverside	1.27%	0.29%	0.00%	24.34%	5.11%	2.32%	3.87%	3.25%	**4.73%**
BATRACHOIDFORMES	Batrachoididae	*Opsanus beta*	Gulf Toadfish	0.16%					0.39%		0.08%	**0.08%**
BELONIFORMES	Belonidae	*Strongylura marina*	Atlanitc Needlefish					0.32%				**0.03%**
		Strongylura notata	Redfin Needlefish		0.29%							**0.03%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	32.96%	11.18%	23.24%	10.05%	3.19%	13.51%	20.72%	40.53%	**25.40%**
	Fundulidae	*Adinia xenica*	Diamond Killifish	0.16%							1.58%	**0.54%**
		Floridichthys carpio	Goldspotted Killifish	19.75%	17.94%	4.15%	2.65%	8.95%	13.90%	4.14%	6.09%	**9.60%**
		Fundulus confluentus	Marsh Killifish	1.75%			0.26%			0.28%	0.33%	**0.46%**
		Fundulus grandis	Gulf Killifish	3.50%	0.29%			0.64%			3.09%	**1.67%**
		Fundulus similis	Longnose Killifish	1.11%							1.00%	**0.51%**
		Lucania goodeii	Bluefin Killifish							0.28%		**0.03%**
		Lucania parva	Rainwater Killifish	25.00%	38.82%	40.25%	22.22%	12.78%	23.17%	42.82%	30.69%	**29.38%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish		0.29%	0.41%	0.53%	0.32%				**0.13%**
		Gambusia affinis	Mosquitofish	0.80%	4.12%	1.66%	0.26%	2.56%	0.39%	0.55%	3.67%	**2.12%**
		Poecilia latipinna	Sailfin Molly	2.39%	1.47%	0.41%	0.26%	11.18%	4.25%	3.04%	4.59%	**3.60%**
PERCIFORMES	Centrarchidae	*Lepomis macrochirus*	Bluegill Sunfish				2.12%					**0.22%**
		Lepomis marginatus	Dollar Sunfish			0.41%		0.32%				**0.05%**
		Lepomis microlophus	Redear Sunfish				0.26%	0.32%				**0.05%**
		Lepomis punctatus	Spotted Sunfish			1.24%	1.06%	12.78%				**1.26%**
	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid	0.32%	6.18%	9.96%	4.23%	17.25%	18.15%	9.67%	0.67%	**5.56%**
		Hemichromis bimaculatus	Jewelfish					0.64%				**0.05%**
		Tilapia mariae	Spotted Tilapia			2.49%	1.59%	0.64%				**0.38%**
	Gerridae	*Gerridae spp.*	Mojarra spp.	1.91%	7.06%	2.49%	3.44%	2.24%	6.56%	0.28%	0.08%	**2.18%**
	Gobiidae	*Gobiosoma bosci*	Naked Goby							0.28%	0.08%	**0.05%**
		Microgobius gulosus	Clown Goby	8.76%	11.76%	13.28%	25.93%	20.77%	17.37%	14.09%	4.25%	**11.75%**
PLEURONECTIFORMES	Achiridae	*Trinectes maculatus*	Hogchoker (Flounder)				0.26%					**0.03%**
SILURIFORMES	Clariidae	*Clarias batrachus*	Walking Catfish				0.26%					**0.03%**
SYNBRANCHIFORMES	Mastacembelidae	*Macrognathus siamensis*	Spiny Eel				0.26%					**0.03%**
	Synbranchidae	*Monopterus albus*	Asian Swamp Eel		0.29%							**0.03%**
			Totals									
			Number of Fish	628	340	241	378	313	259	362	1199	**3720**
			Number of Species	15	13	13	18	17	10	12	15	**30**
			Number of Nets Sampled	18	18	18	16	14	17	18	15	**134**

Table 14. Percent catch for all fish collected during each monthly sample in the C-111 Watershed throughout 2012-13, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

C-111 Watershed 2012-13									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater	0.16%	0.29%	4.15%	5.56%	14.06%		0.28%		**2.10%**
Oligohaline	63.38%	62.06%	75.93%	37.83%	47.92%	59.46%	77.35%	82.15%	**67.31%**
Mesohaline	13.54%	12.65%	13.28%	50.53%	26.52%	19.69%	17.96%	10.59%	**18.20%**
Polyhaline	22.93%	25.00%	6.64%	6.08%	11.18%	20.85%	4.42%	7.26%	**12.37%**
Euhaline									
Unknown					0.32%				**0.03%**
Totals									
Number of Fish	628	340	241	378	313	259	362	1199	**3720**
Number of Salinity Classes	4	4	4	4	5	3	4	3	**5**
Number of Species	15	13	13	18	17	10	12	15	**30**
Number of Nets Sampled	18	18	18	16	14	17	18	15	**134**

Table 15. Phylogenetic list of all species sampled and the percent catch for each month during 2008-09 for the C-111 Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

C111 Watershed 2008-09												
ORDER	**Family**	***Genus Species***	**Common Name**	**Jun**	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
			Unknown Larval Species							0.32%		**0.02%**
ATHERINIFORMES	Atherinidae	*Menidia peninsulae*	Tidewater Silverside	0.19%	0.51%	0.27%				3.25%	5.42%	**1.37%**
BATRACHOIDFORMES	Batrachoididae	*Opsanus beta*	Gulf Toadfish	0.19%			0.15%		0.74%		0.13%	**0.12%**
BELONIFORMES	Belonidae	*Strongylura marina*	Atlantic needlefish	0.10%							0.13%	**0.05%**
		Strongylura notata	Redfin Needlefish								0.13%	**0.02%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	43.60%	23.29%	14.86%	23.80%	4.16%	19.12%	12.01%	69.99%	**33.12%**
	Fundulidae	*Adinia xenica*	Diamond Killifish	2.62%		0.27%	3.36%		1.47%	1.62%	1.51%	**1.66%**
		Floridichthys carpio	Goldspotted Killifish	7.17%	29.11%	31.08%	16.35%	18.61%	5.88%	4.55%	1.39%	**12.86%**
		Fundulus confluentus	Marsh Killifish	1.84%	0.25%	0.81%	2.48%	1.39%	7.35%	0.97%	1.77%	**1.75%**
		Fundulus grandis	Gulf Killifish	14.15%	0.51%		1.17%	8.71%	13.24%	9.74%	2.90%	**6.42%**
		Fundulus similis	Longnose Killifish	0.19%								**0.05%**
		Lucania parva	Rainwater Killifish	20.45%	35.95%	26.22%	23.21%	31.29%	25.74%	39.61%	9.21%	**23.60%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish		0.25%							**0.02%**
		Gambusia affinis	Mosquitofish	0.29%	0.51%		0.29%		0.74%	0.32%	1.64%	**0.52%**
		Poecilia latipinna	Sailfin Molly	7.27%	0.51%	3.78%	12.70%	26.53%	19.12%	26.30%	1.64%	**10.23%**
GASTEROSTEIFORMES	Syngnathidae	*Syngnathus louisianae*	Chain Pipefish			0.27%						**0.02%**
PERCIFORMES	Centrarchidae	*Lepomis gulosus*	Warmouth				0.29%		0.74%			**0.07%**
		Lepomis marginatus	Dollar Sunfish				0.58%	0.99%				**0.21%**
		Lepomis punctatus	Spotted Sunfish				1.02%		3.68%			**0.28%**
	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid		3.04%	7.84%	8.18%	6.53%				**3.08%**
	Gerridae	*Gerridae spp.*	Mojarra spp.		0.25%					0.32%		**0.05%**
	Gobiidae	*Gobiosoma bosci*	Naked Goby		0.51%							**0.05%**
		Lophogobius cyprinoides	Crested Goby			0.54%						**0.05%**
		Microgobius gulosus	Clown Goby	1.84%	5.32%	14.05%	5.26%	1.78%	2.21%	0.97%	4.16%	**4.17%**
PLEURONECTIFORMES	Achiridae	*Trinectes maculatus*	Hogchoker (Flounder)	0.10%								**0.02%**
SYNBRANCHIFORMES	Mastacembelidae	*Macrognathus siamensis*	Spiny Eel				1.17%					**0.19%**
			Totals									
			Number of Fish	505	136	308	793	1032	395	370	685	**4224**
			Number of Species	14	13	11	15	9	12	12	13	**26**
			Number of Nets Sampled	9	10	14	16	17	18	17	16	**117**

Table 16. Percent catch for all fish collected during each monthly sample in the C-111 Watershed throughout 2012-13, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

C-111 Watershed 2008-09									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater	0.10%			3.07%	0.99%	4.41%		0.00%	**0.78%**
Oligohaline	76.07%	64.30%	54.32%	74.01%	69.90%	73.53%	80.84%	85.75%	**74.08%**
Mesohaline	16.18%	6.33%	14.32%	6.42%	10.50%	15.44%	14.29%	12.61%	**12.00%**
Polyhaline	7.56%	29.37%	31.35%	16.50%	18.61%	6.62%	4.87%	1.51%	**13.09%**
Euhaline								0.13%	**0.02%**
Unknown	0.10%								**0.02%**
Totals									
Number of Fish	1032	395	370	685	505	136	308	793	**4224**
Number of Salinity Classes	5	3	3	4	4	4	3	5	**6**
Number of Species	14	13	11	15	9	12	12	13	**26**
Number of Nets Sampled	17	18	17	16	9	10	14	16	**117**

Table 17. Phylogenetic list of all species sampled and the percent catch for each month during 2012-13 for the SBB Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

South Biscayne Bay Watershed 2012-13												
ORDER	**Family**	***Genus Species***	**Common Name**	**Jun**	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
ATHERINIFORMES	Atherinidae	Atherinomorus stipes	Hardhead Silverside			0.25%	8.88%					**0.76%**
		Menidia peninsulae	Tidewater Silverside	1.80%		0.12%		7.05%	0.31%		0.45%	**2.34%**
BATRACHOIDFORMES	Batrachoididae	*Opsanus beta*	Gulf Toadfish	3.38%	3.52%	1.11%	0.33%	0.54%	0.93%		0.45%	**1.30%**
BELONIFORMES	Belonidae	*Strongylura notata*	Redfin Needlefish	0.90%	0.23%		0.33%	0.18%			1.79%	**0.31%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	1.13%	0.47%	0.62%	0.66%	0.62%	2.48%			**0.76%**
	Fundulidae	*Floridichthys carpio*	Goldspotted Killifish	40.54%	15.26%	1.86%	10.86%	18.64%	8.07%	16.93%	18.30%	**15.66%**
		Fundulus grandis	Gulf Killifish					0.09%				**0.03%**
		Lucania parva	Rainwater Killifish	17.34%	30.05%	15.10%	8.55%	14.99%	22.67%	21.69%	28.13%	**18.19%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish		0.23%				0.31%			**0.05%**
		Gambusia affinis	Mosquitofish	5.41%	5.63%	6.19%	4.61%	2.23%	4.35%	2.65%	10.27%	**4.66%**
		Gambusia rhizophorae	Mangrove Mosquitofish				0.66%	0.45%	0.62%			**0.23%**
		Poecilia latipinna	Sailfin Molly	1.35%	5.16%	3.34%	3.62%	1.25%	0.62%	1.06%	0.89%	**2.24%**
GASTEROSTEIFORMES	Syngnathidae	*Syngnathus scovelli*	Gulf Pipefish	0.45%								**0.05%**
		Cosmocampus elucens	Shortfin Pipefish	0.23%				1.07%	0.62%		0.89%	**0.44%**
PERCIFORMES	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid			0.12%		0.09%				**0.05%**
	Gerridae	*Gerridae spp.*	Mojarra spp.	2.93%	10.56%	4.58%	14.14%	5.17%	22.05%	10.05%	9.38%	**8.00%**
	Gobiidae	*Microgobius gulosus*	Clown Goby	24.55%	28.64%	66.71%	47.37%	47.46%	36.65%	47.09%	29.02%	**44.76%**
	Lutjanidae	*Lutjanus griseus*	Gray Snapper		0.23%			0.18%	0.31%		0.45%	**0.13%**
PLEURONECTIFORMES	Achiridae	*Trinectes maculatus*	Hogchoker (Flounder)							0.53%		**0.03%**
			Totals									
			Number of Fish	444	426	808	304	1121	322	189	224	**3838**
			Number of Species	12	11	11	11	15	13	7	11	**19**
			Number of Nets Sampled	18	18	18	18	18	18	18	18	**144**

Table 18. Percent catch for all fish collected during each monthly sample in the SBB Watershed throughout 2012-13, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

Southern Biscayne Bay Watershed 2012-13									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater									
Oligohaline	25.23%	41.55%	25.37%	17.43%	19.18%	30.43%	25.40%	39.29%	**25.95%**
Mesohaline	27.25%	28.87%	66.83%	47.70%	54.77%	36.96%	47.62%	31.25%	**47.47%**
Polyhaline	47.52%	29.34%	7.80%	34.87%	25.87%	32.30%	26.98%	29.02%	**26.45%**
Euhaline		0.23%			0.18%	0.31%		0.45%	**0.13%**
Unknown									
Totals									
Number of Fish	444	426	808	304	1121	322	189	224	**3838**
Number of Salinity Classes	3	4	3	3	4	4	3	4	**4**
Number of Species	12	11	11	11	15	13	7	11	**19**
Number of Nets Sampled	18	18	18	18	18	18	18	18	**144**

Table 19. Phylogenetic list of all species sampled and the percent catch for each month during 2008-09 for the SBB Watershed. Percent catch for all months combined, total fish collected per month, number of species collected, and total number of nets sampled are also included. All fish collected are represented, however, only fish less than 6.5cm were used in subsequent analyses.

Southern Biscayne Bay Watershed 2008-09												
ORDER	**Family**	***Genus Species***	**Common Name**	**Jun**	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
ATHERINIFORMES	Atherinidae	*Menidia peninsulae*	Tidewater Silverside	1.06%	1.31%	1.46%	0.16%	1.99%				**0.89%**
BATRACHOIDFORMES	Batrachoididae	*Opsanus beta*	Gulf Toadfish	2.31%	0.84%	1.14%	0.23%	1.46%	0.15%		2.40%	**1.01%**
	Belonidae	*Strongylura notata*	Redfin Needlefish	0.10%			0.08%			0.30%	0.60%	**0.06%**
CYPRINODONTIFORMES	Cyprinodontidae	*Cyprinodon variegatus*	Sheepshead Minnow	17.15%	1.87%	0.16%	12.67%	5.22%	30.38%	4.75%	7.78%	**10.56%**
	Fundulidae	*Adinia xenica*	Diamond Killifish						0.73%			**0.08%**
		Floridichthys carpio	Goldspotted Killifish	41.14%	31.49%	34.15%	36.16%	19.85%	30.96%	44.81%	52.10%	**33.78%**
		Fundulus confluentus	Marsh Killifish					0.31%	1.60%			**0.23%**
		Fundulus grandis	Gulf Killifish	0.77%				0.10%	0.73%	0.30%	0.60%	**0.26%**
		Lucania parva	Rainwater Killifish	6.26%	15.46%	9.59%	2.95%	10.34%	7.27%	5.34%	7.78%	**8.24%**
	Poeciliidae	*Belonesox belizanus*	Pike Killifish				0.08%					**0.02%**
		Gambusia affinis	Mosquitofish	5.11%	2.62%	0.98%	0.86%	7.42%	2.03%	6.53%	6.59%	**3.51%**
		Gambusia rhizophorae	Mangrove Mosquitofish	0.77%	0.56%	0.65%	0.08%	1.04%				**0.47%**
		Poecilia latipinna	Sailfin Molly	3.95%	0.28%		9.02%	12.23%	11.63%	32.34%	9.58%	**7.83%**
GASTEROSTEIFORMES	Syngnathidae	*Syngnathus louisianae*	Chain Pipefish			0.16%						**0.02%**
		Cosmocampus elucens	Shortfin Pipefish	0.10%				0.10%				**0.03%**
	Cichlidae	*Cichlasoma urophthalmus*	Mayan Cichlid				0.16%	0.21%				**0.06%**
	Gerridae	*Gerridae spp.*	Mojarra spp.	4.24%	1.78%	3.41%	15.94%	0.84%	0.15%		1.20%	**4.87%**
	Gobiidae	*Lophogobius cyprinoides*	Crested Goby	0.10%	0.09%							**0.03%**
		Microgobius gulosus	Clown Goby	16.96%	43.58%	48.29%	21.54%	38.87%	14.39%	5.64%	11.38%	**28.01%**
	Lutjanidae	*Lutjanus griseus*	Gray Snapper		0.09%		0.08%					**0.03%**
			Totals									
			Number of Fish	1038	1067	615	1286	957	688	337	167	**6155**
			Number of Species	14	12	10	14	14	11	8	10	**20**
			Number of Nets Sampled	18	18	18	18	17	18	18	18	**143**

Table 20. Percent catch for all fish collected during each monthly sample in the SBB Watershed throughout 2008-09, categorized by salinity class. Salinity classes are assigned based on the Venice System of Estuarine Classification; Freshwater (0 - 0.99), Oligohaline (1 - 4.99 psu), Mesohaline (5 - 17.99 psu), Polyhaline (18 - 30 psu), and Euhaline (>30 psu). The unknown category is comprised of species that are not associated with a particular salinity class. Percent catch for all months combined, total fish collected per month, number of salinity classes represented, number of species collected, and total number of nets sampled are also included. All fish collected are represented.

Southern Biscayne Bay Watershed 2008-09									
	Jun	**Sep**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**HY Total**
Freshwater									
Oligohaline	32.47%	20.24%	10.73%	25.74%	35.74%	53.63%	48.96%	31.74%	**30.53%**
Mesohaline	18.88%	44.89%	49.76%	21.77%	40.96%	15.12%	6.23%	12.57%	**29.23%**
Polyhaline	48.55%	34.68%	39.51%	52.41%	23.30%	31.25%	44.81%	55.69%	**40.18%**
Euhaline	0.10%	0.19%		0.08%					**0.06%**
Unknown									
Totals									
Number of Fish	1038	1067	615	1286	957	688	337	167	**6155**
Number of Salinity Classes	4	4	3	4	3	3	3	3	**4**
Number of Species	14	12	10	14	14	11	8	10	**20**
Number of Nets Sampled	18	18	18	18	17	18	18	18	**143**

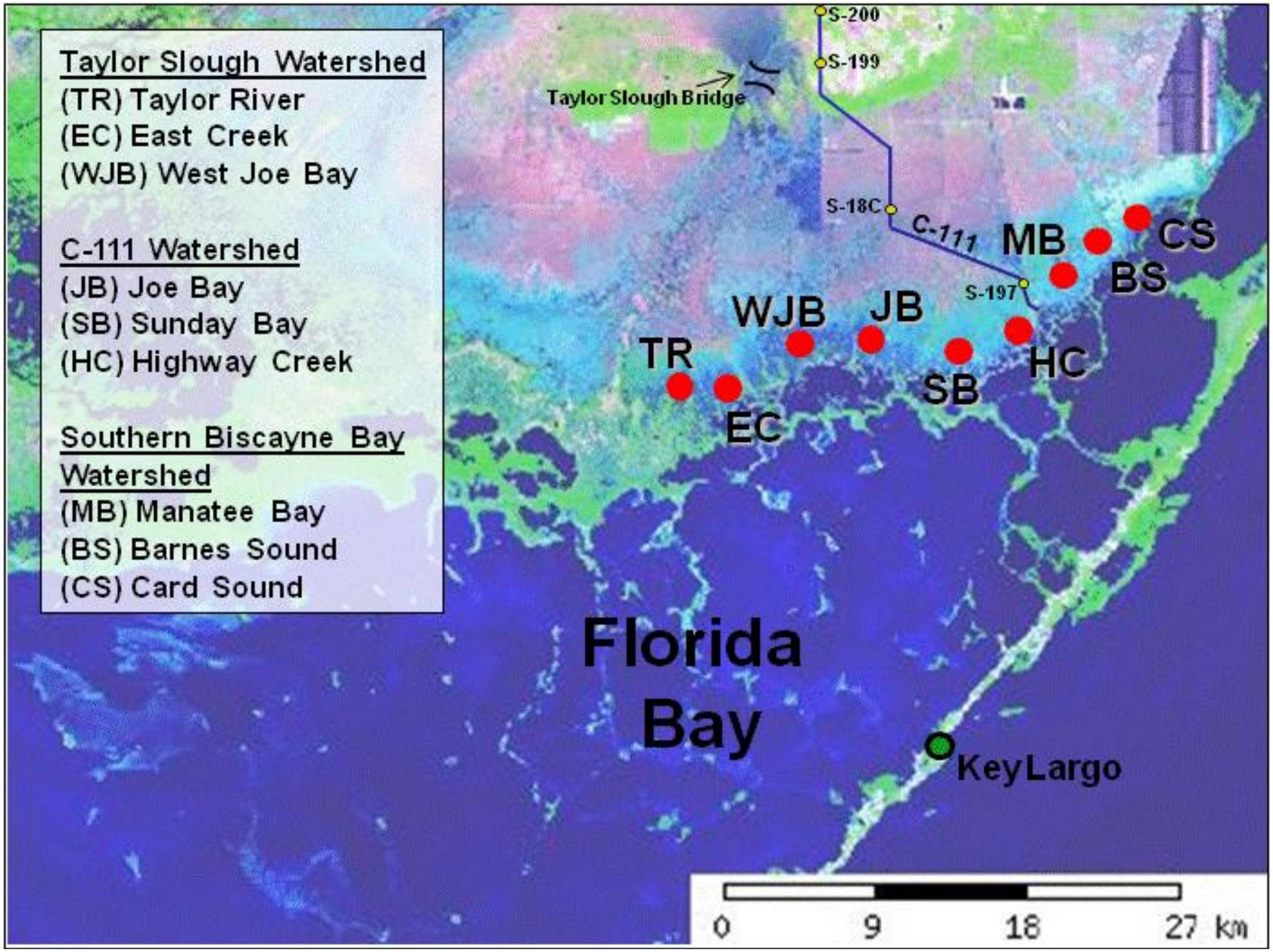


Figure 1. Locations of nine mangrove zone monitoring sites along with locations of Taylor Slough Bridge, C-111 canal, and water management structures.

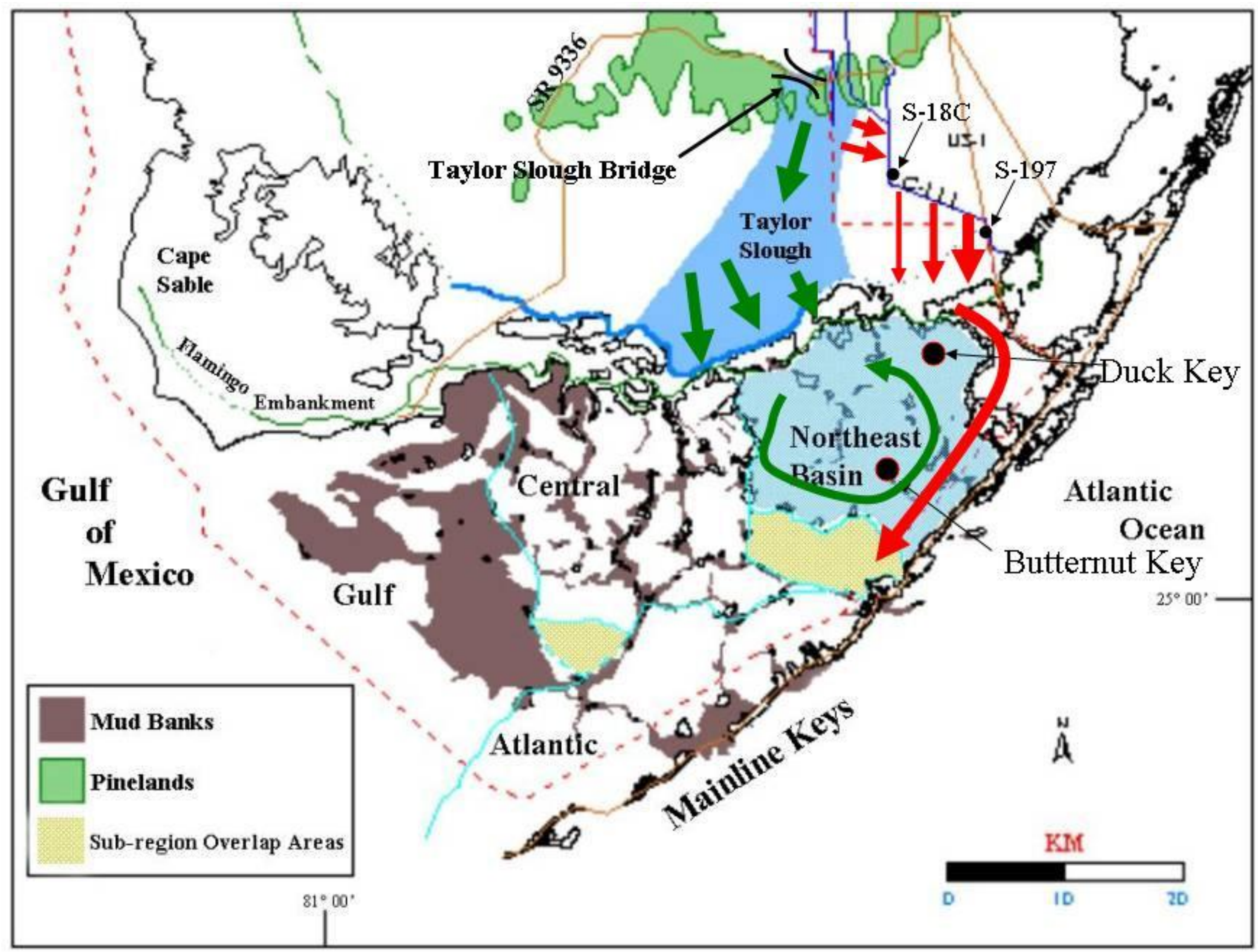


Figure 2. Freshwater flow into Northeastern Florida Bay from Taylor Slough (green arrows) and the C-111 canal (red arrows).

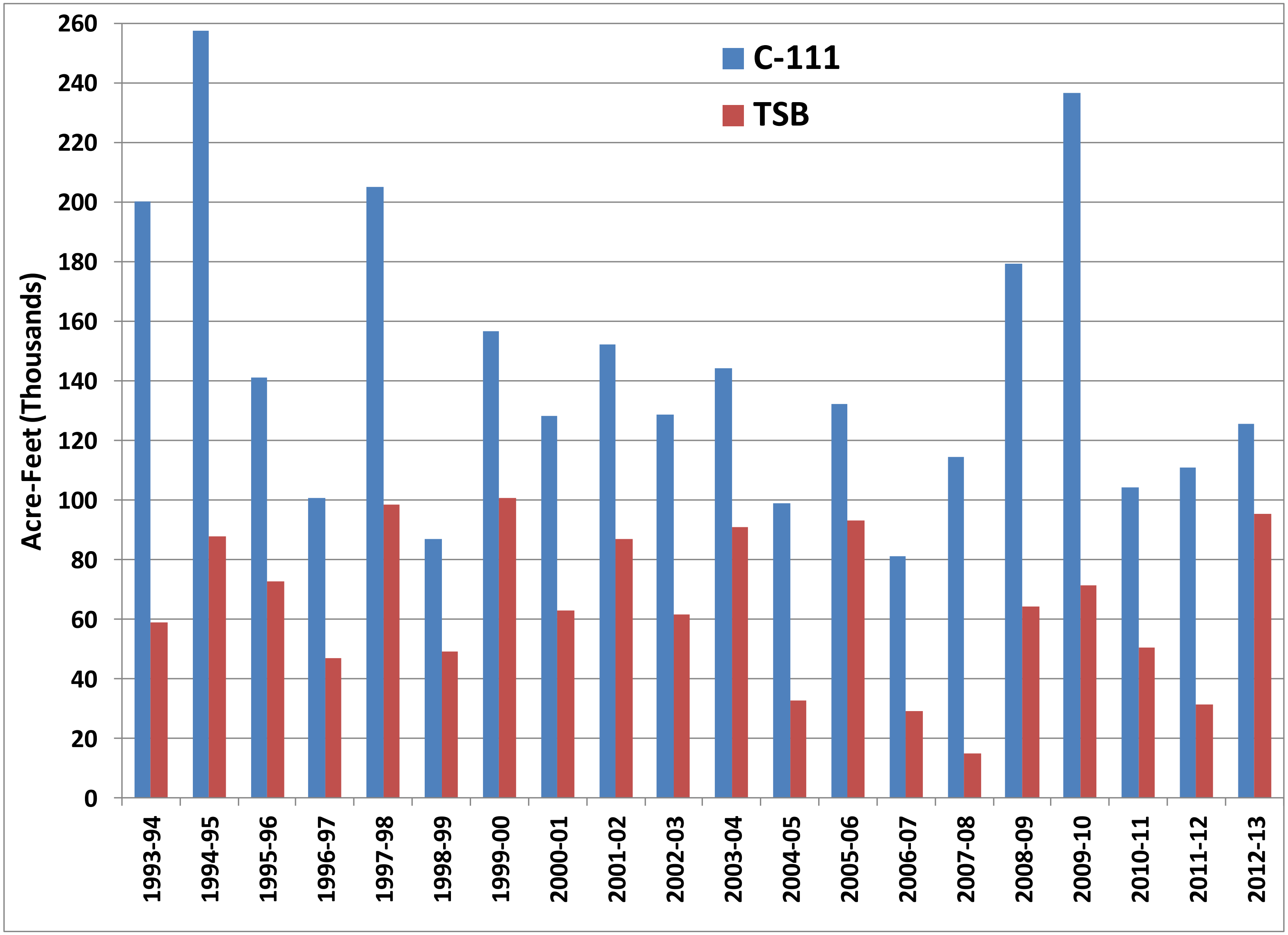


Figure 3. Comparison of annual freshwater flow volumes into Florida Bay via Taylor Slough and the C-111 canal from 1993-94 to 2012-13.

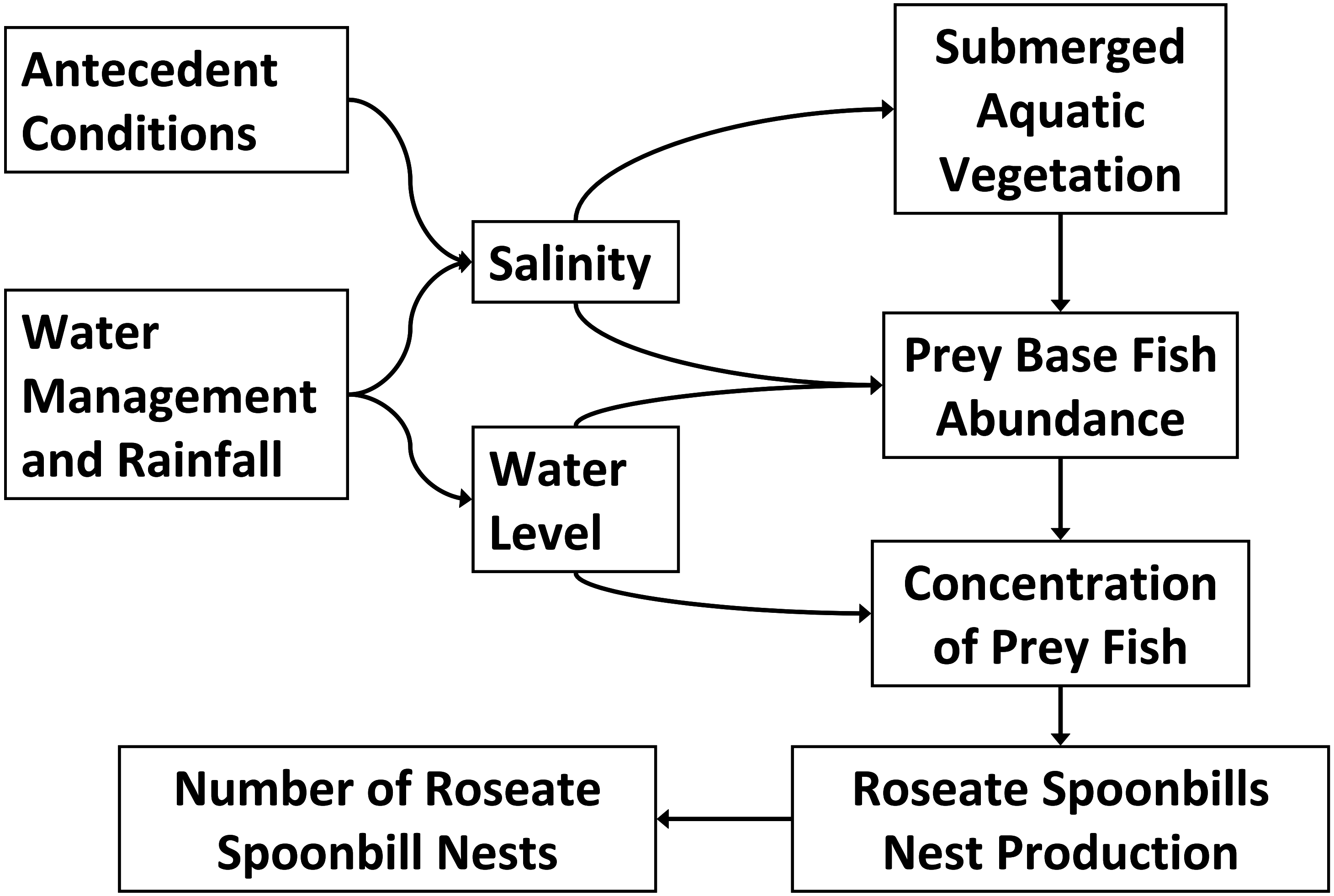


Figure 4. Conceptual ecological model for spoonbills nesting in Florida Bay.

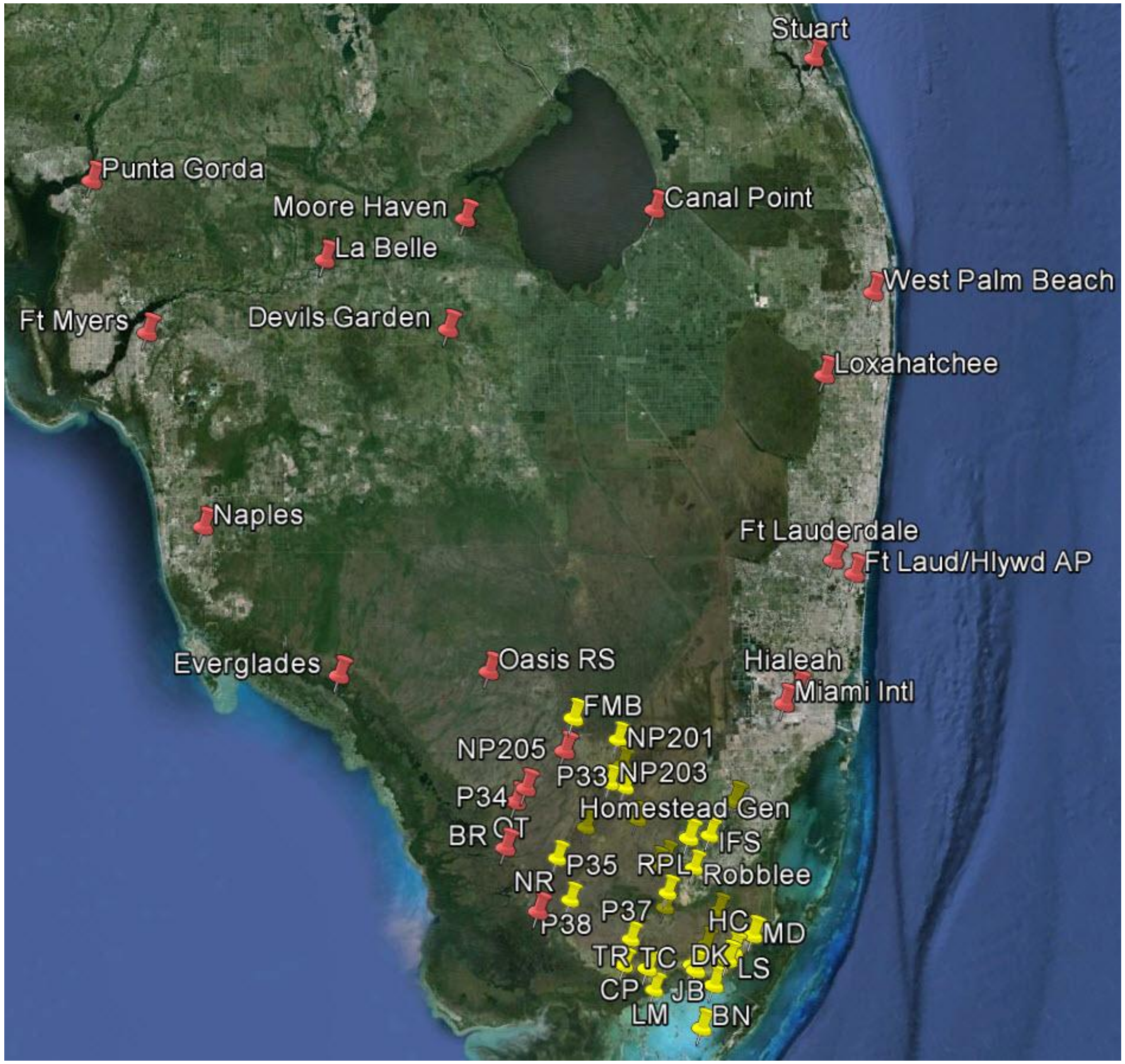


Figure 5. Location of all rainfall gauges used in rainfall analyses. Yellow pins denote those used in local analysis.

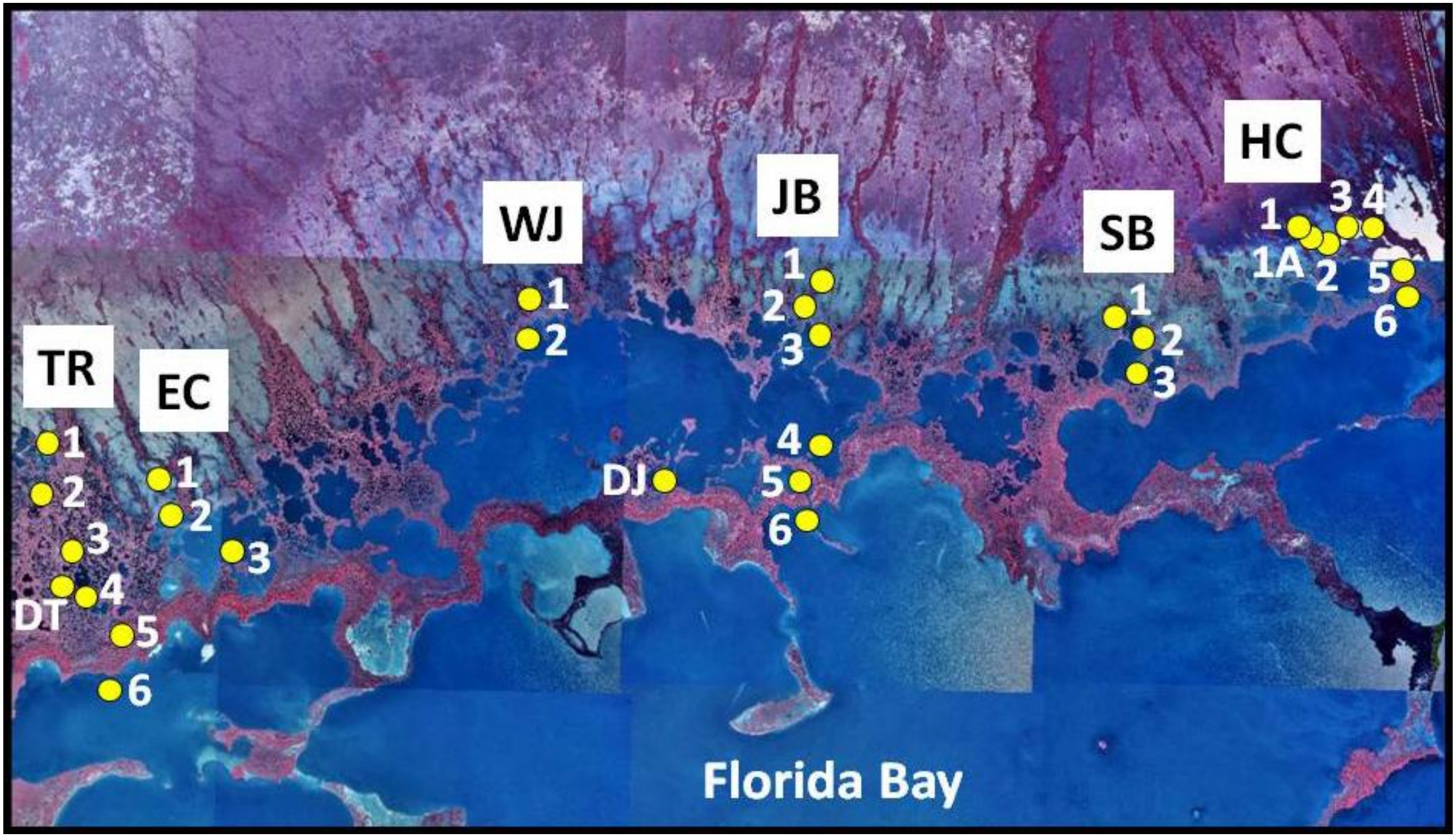


Figure 6. Locations of individual SAV monitoring sub-sites for the northeastern Florida Bay sites.

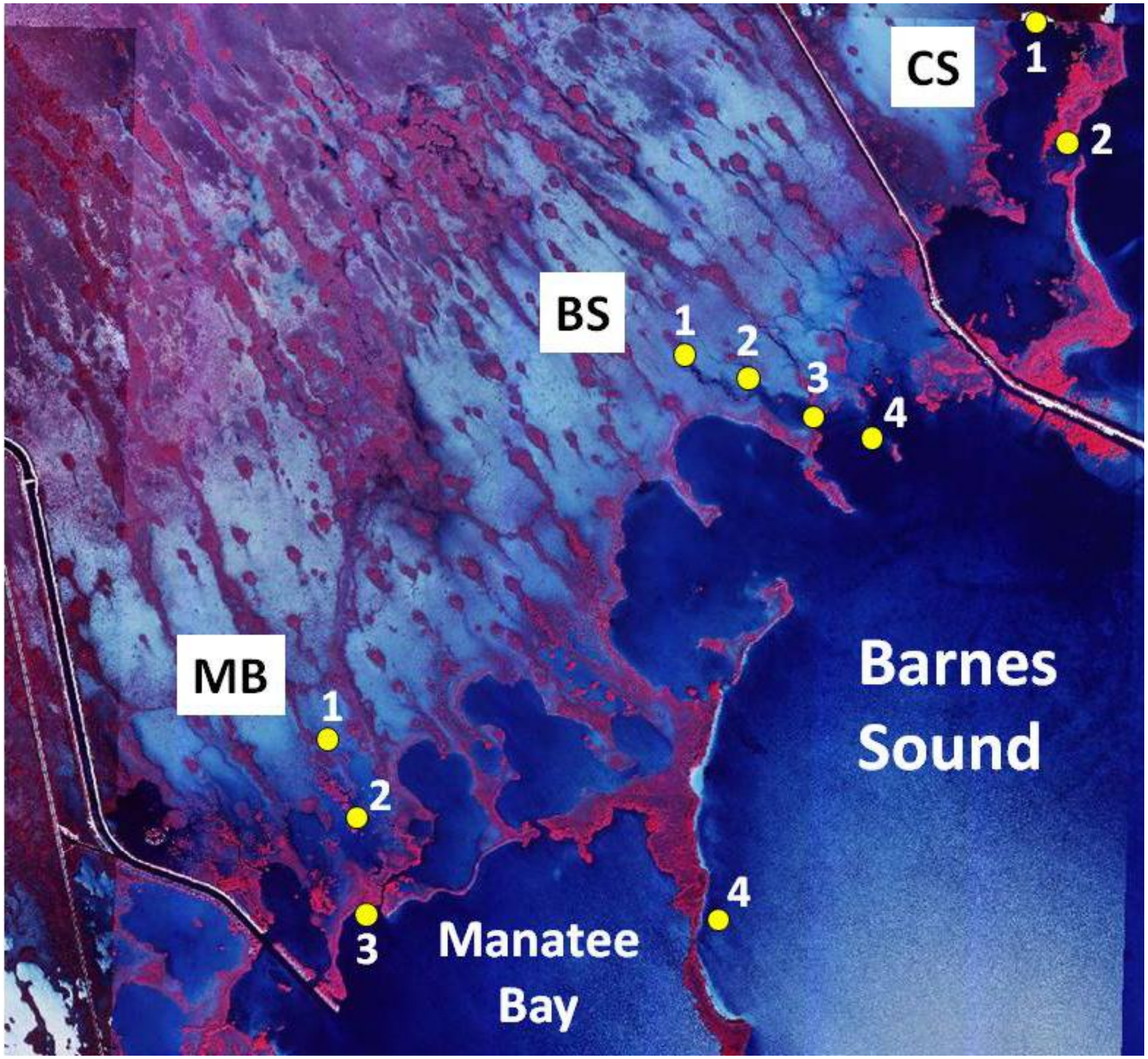


Figure 7. Locations of individual SAV monitoring sub-sites for the southern Biscayne Bay site

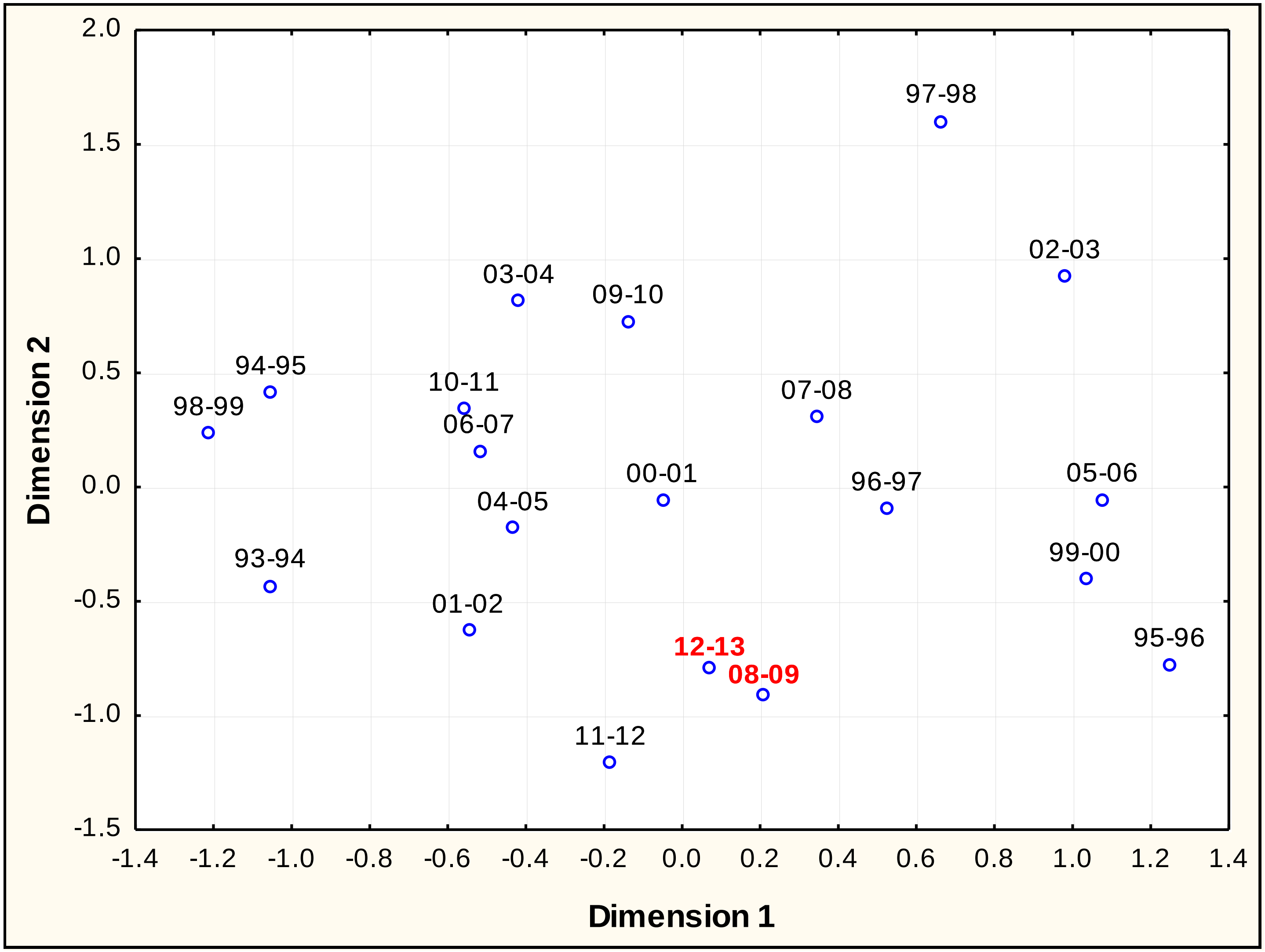


Figure 8. NMDS plot of ordination scores from mean monthly rainfall by hydrologic year for the 20 year period 1993-94 – 2012-13 from 50 rain collection locations in the regional watershed. Subject and comparison years are highlighted in red.

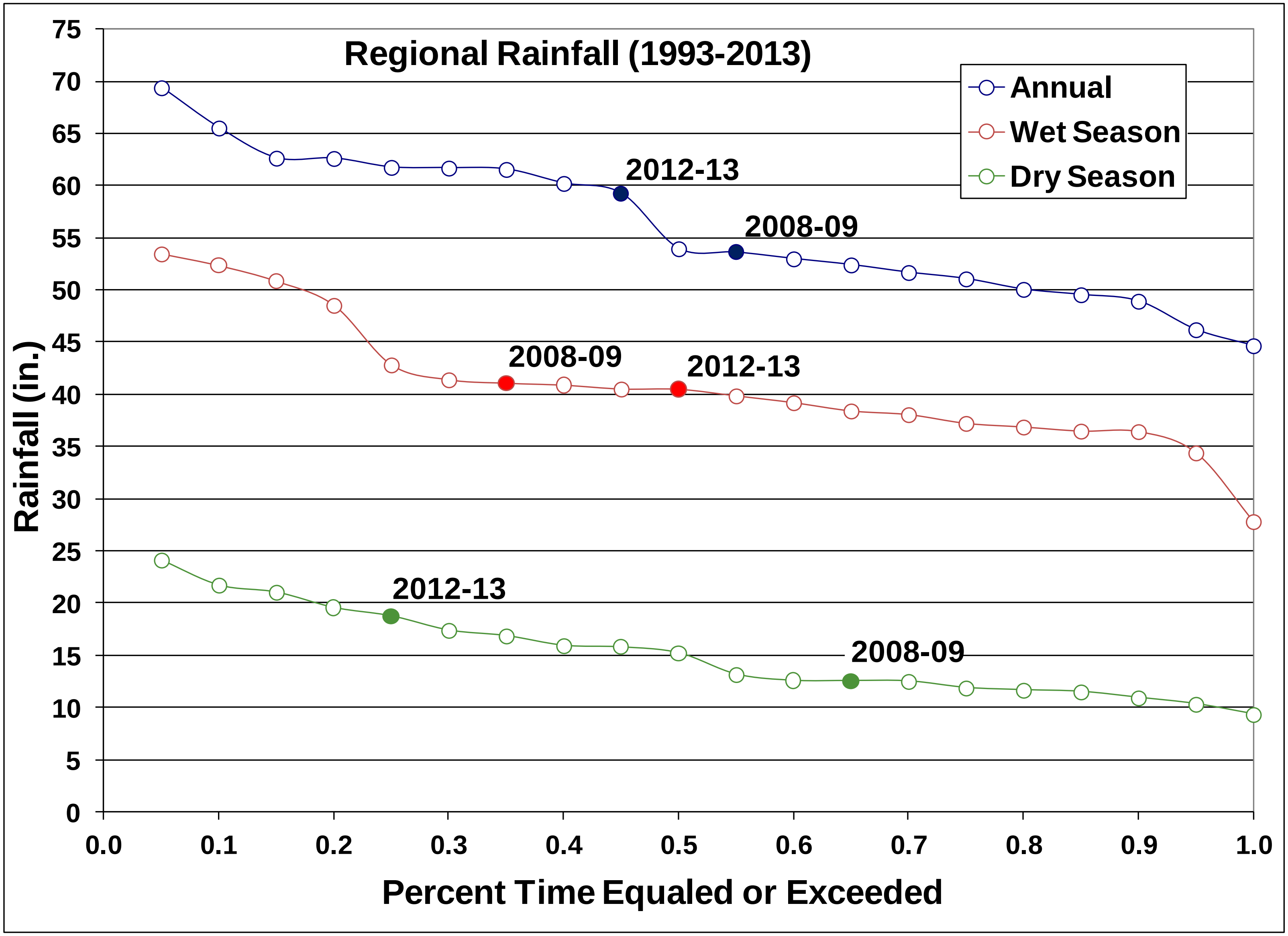


Figure 9. Exceedance curves of annual and seasonal rainfall for the regional watershed for the period of record 1993-94 – 2012-13.

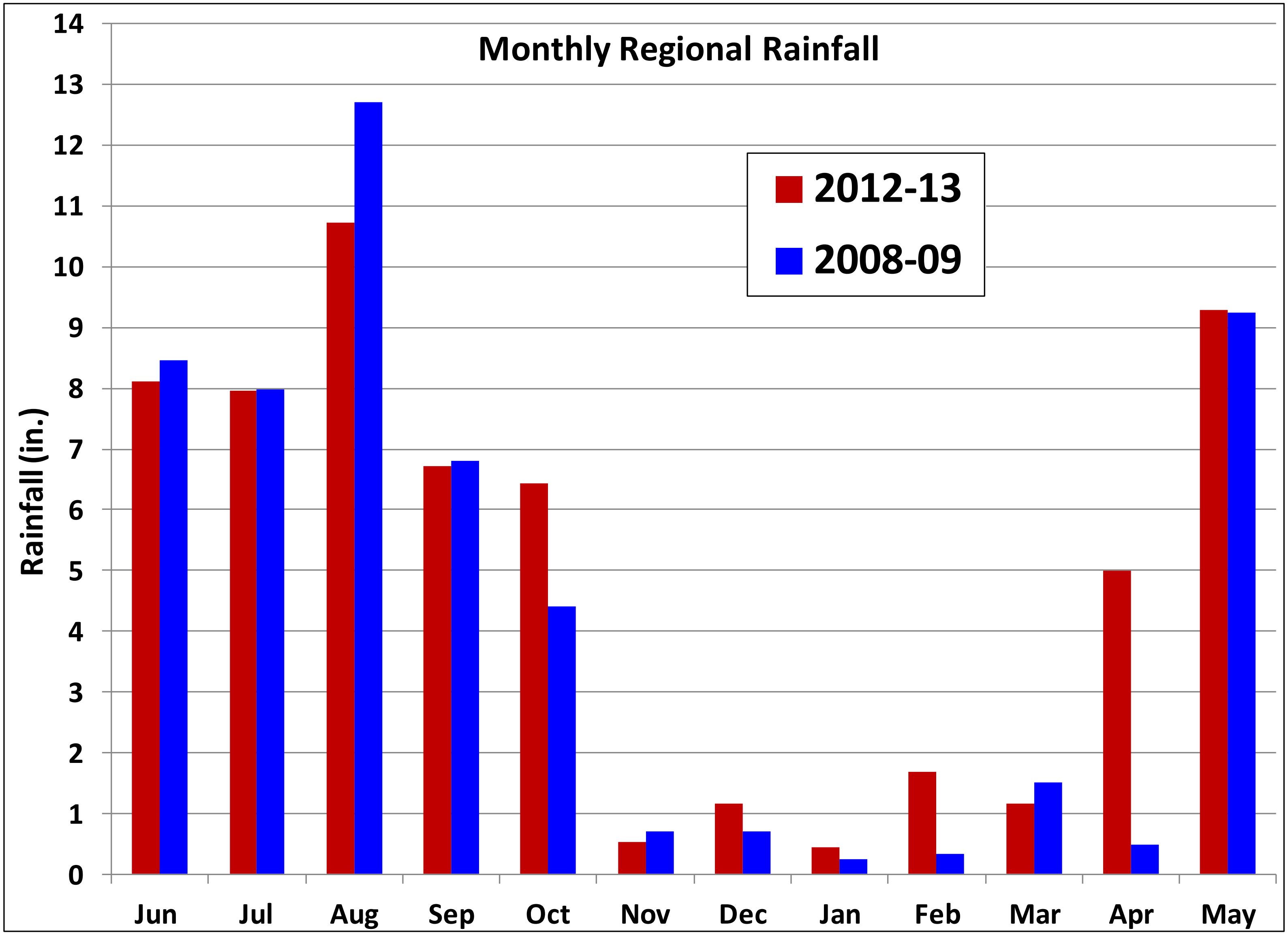


Figure 10. Comparison of monthly rainfall sums between 2012-13 and 2008-09 for the regional watershed.

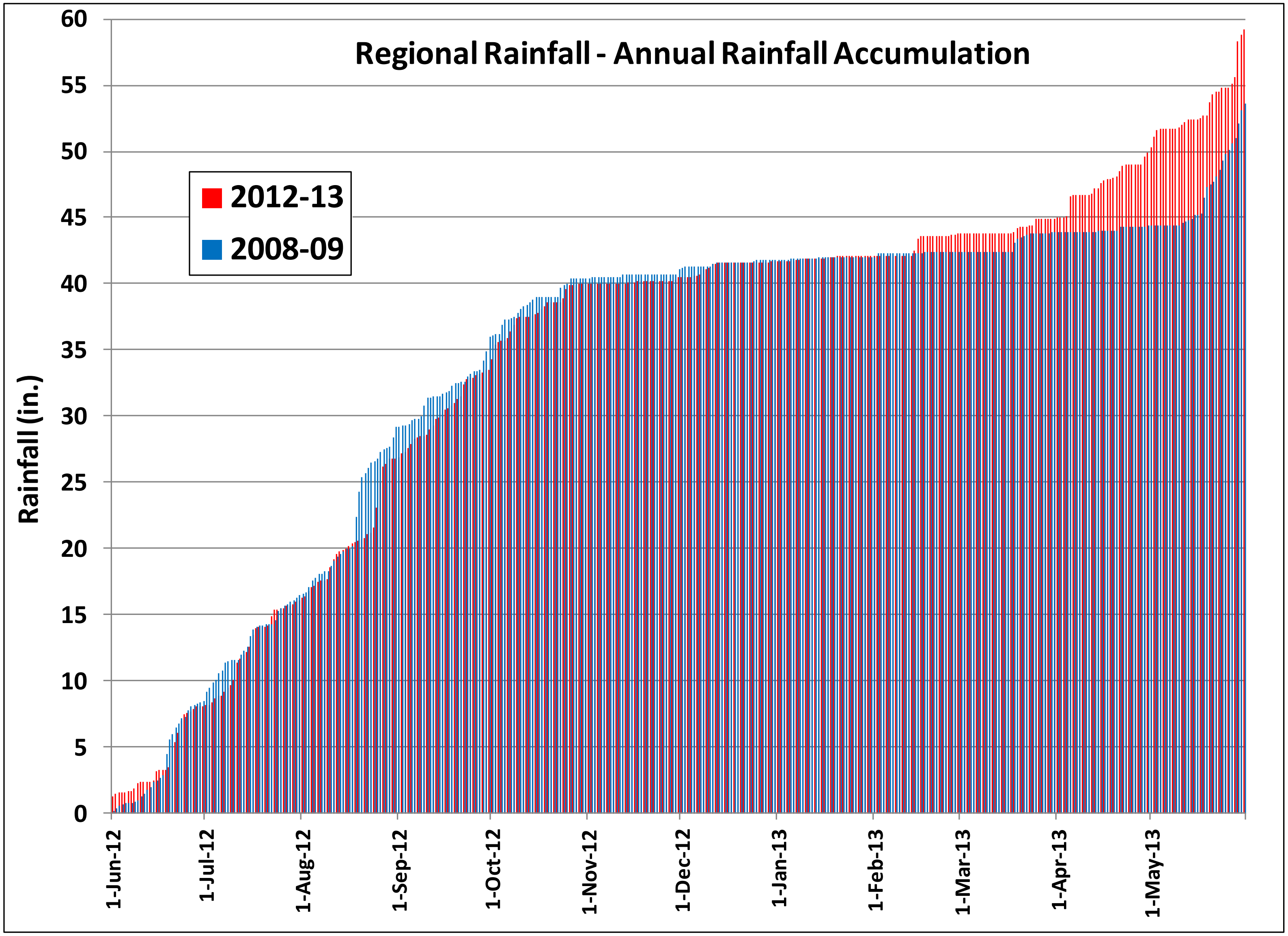


Figure 11. Annual rainfall accumulation during 2012-13 and 2008-09 for the regional watershed.

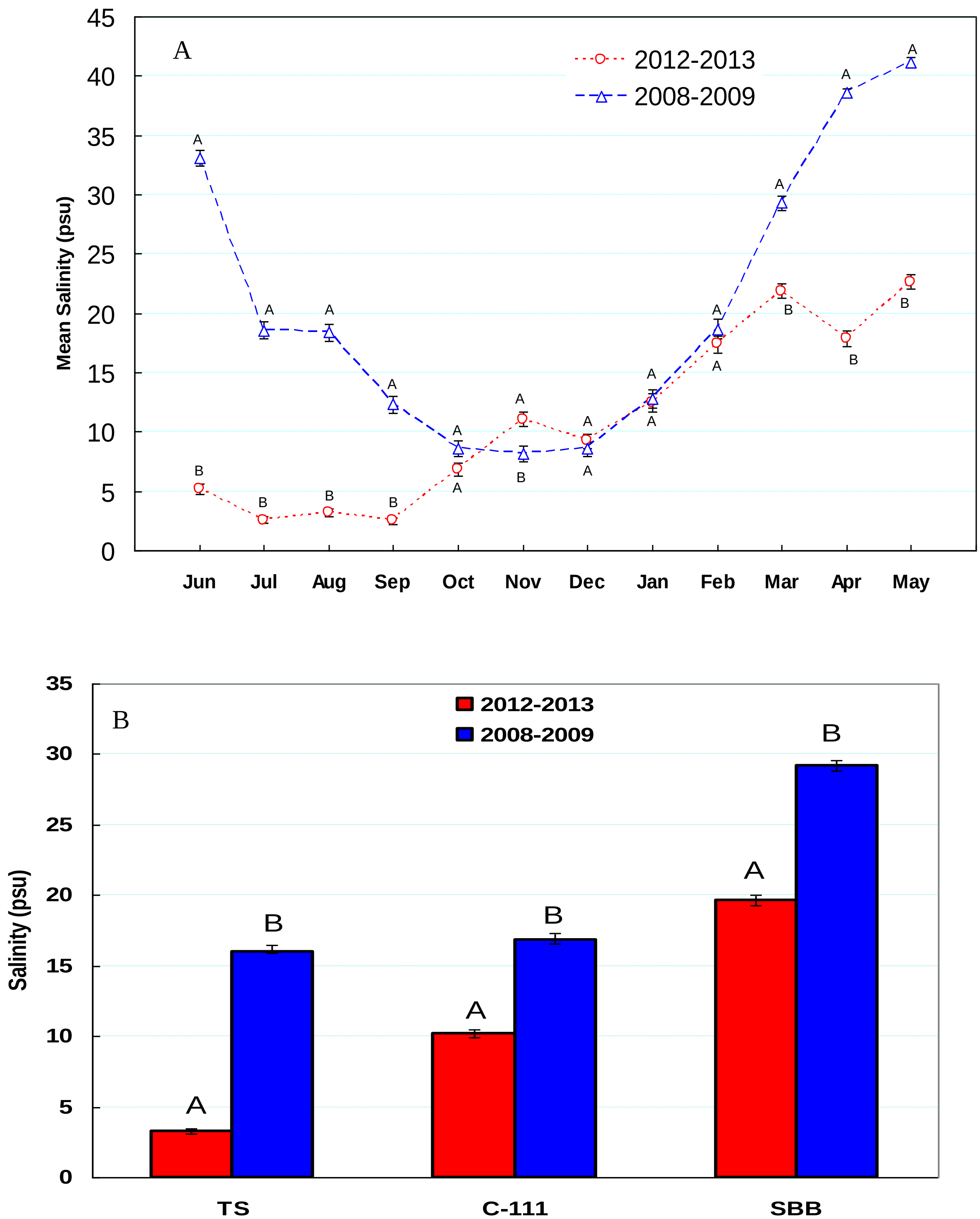


Figure 12. Comparison of mangrove zone salinity (psu) between 2012-13 and 2008-09. A. Mean (±SE) monthly salinity of three watersheds. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly means for that month. B. Mean (±SE) annual salinity in three watersheds. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years at that site

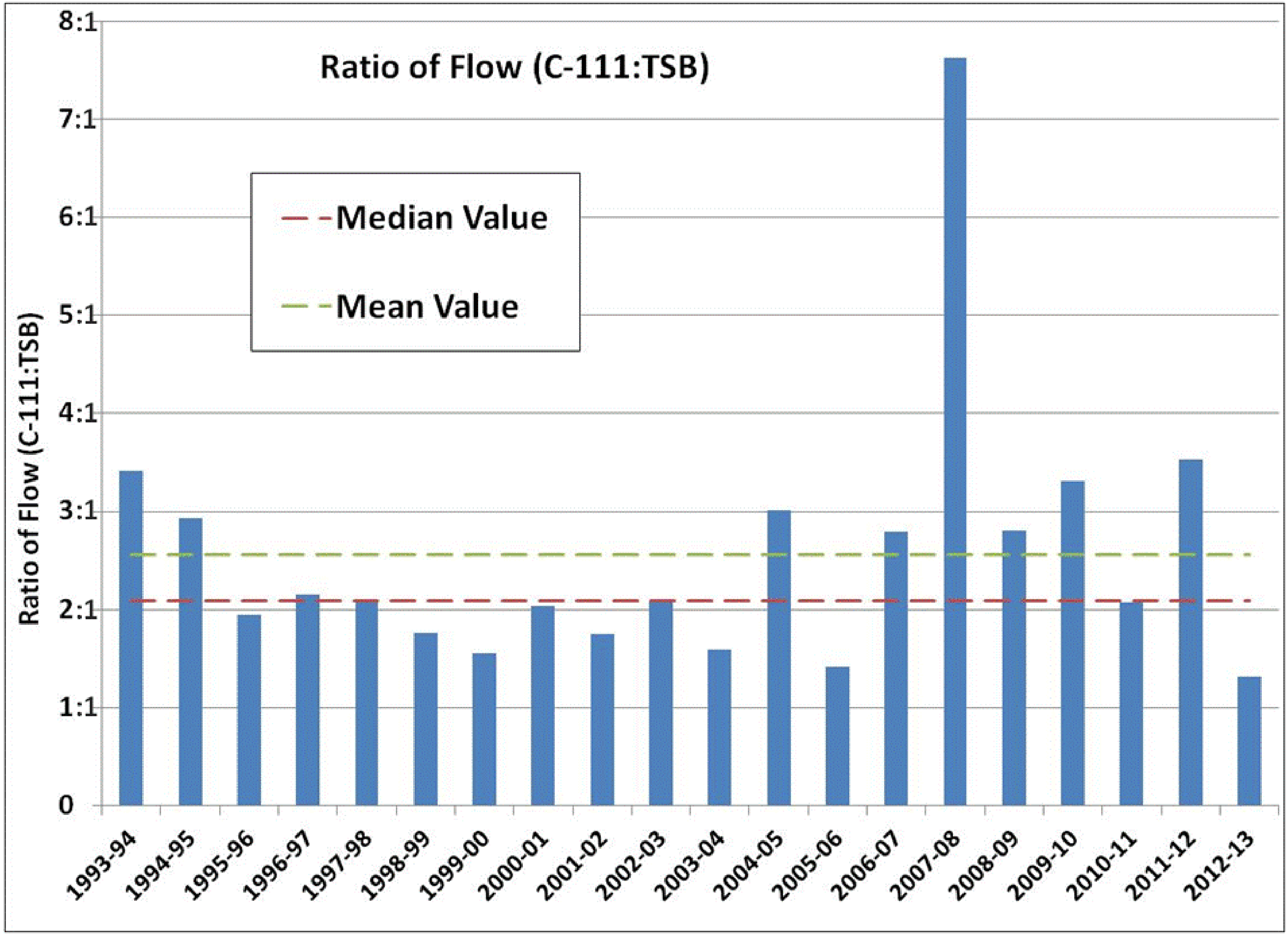


Figure 13. Comparisons of the annual ratio of flow volumes into Florida Bay between the C-111 canal and Taylor Slough for the period 1993-94 – 2012-13.

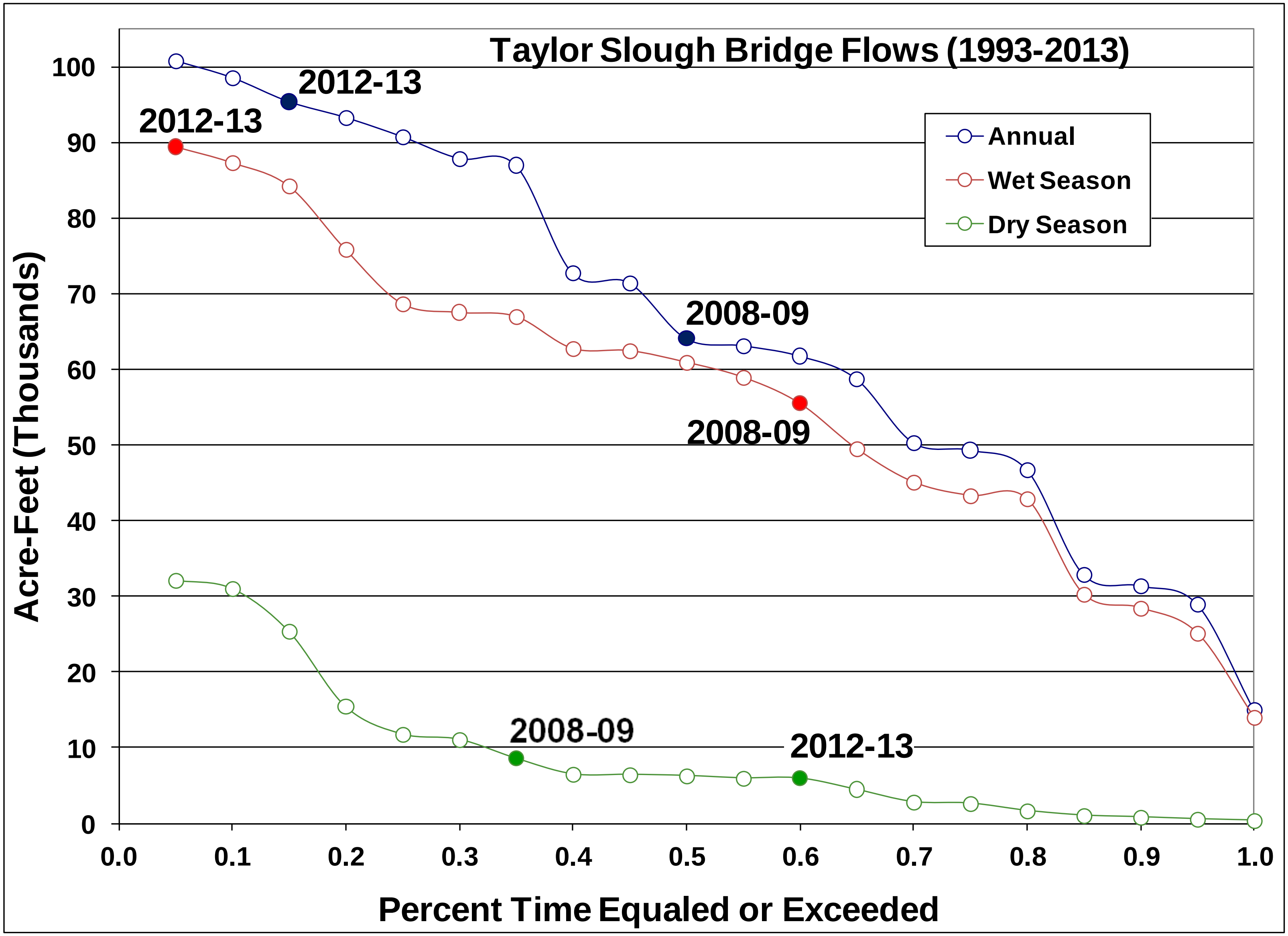


Figure 14. Exceedance curves of annual and seasonal flow through Taylor Slough Bridge for the period of record 1993-94 – 2012-13.

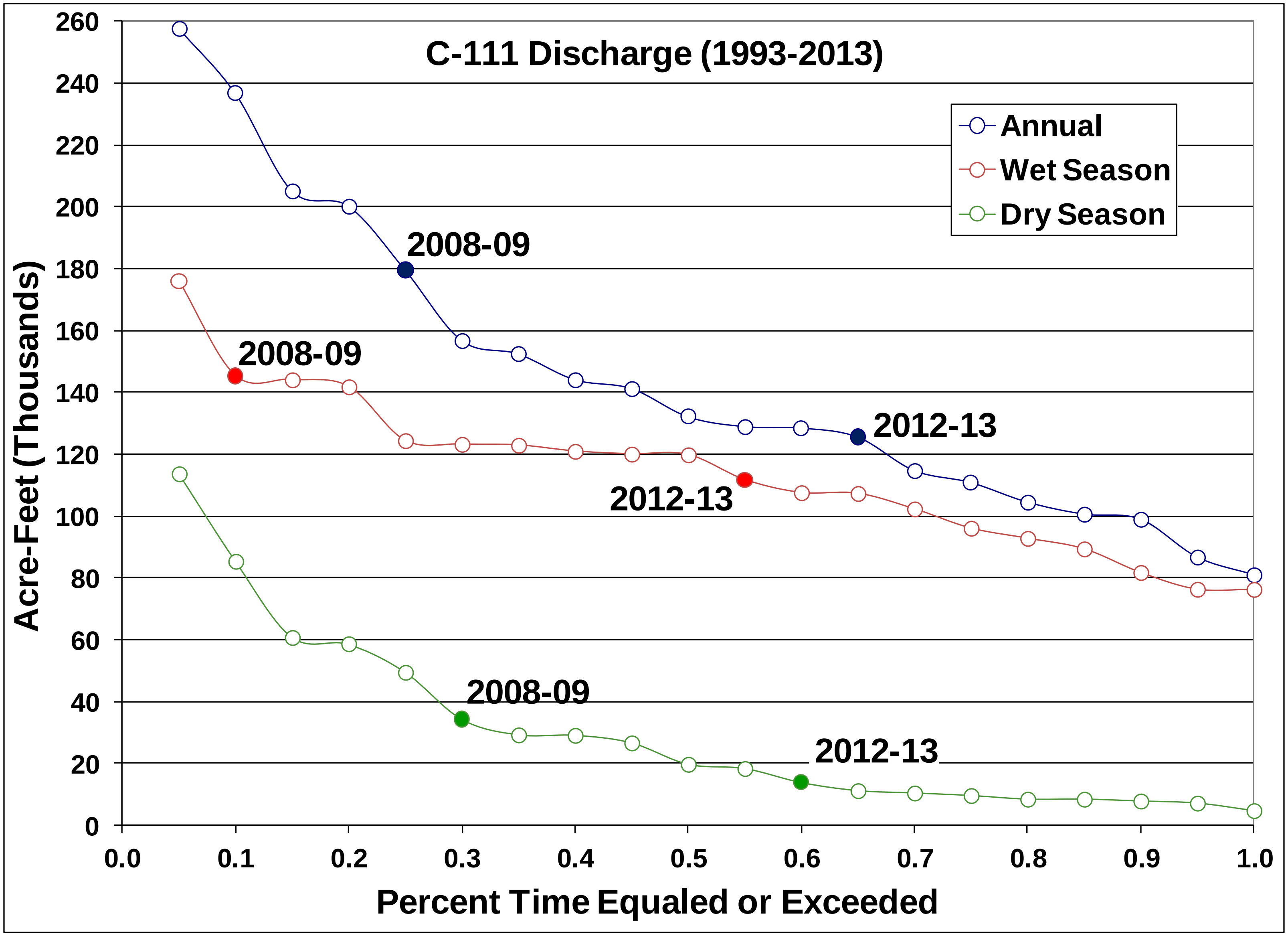


Figure 15. Exceedance curves of annual and seasonal discharge from the C-111 canal for the period of record 1993-94 – 2012-13.

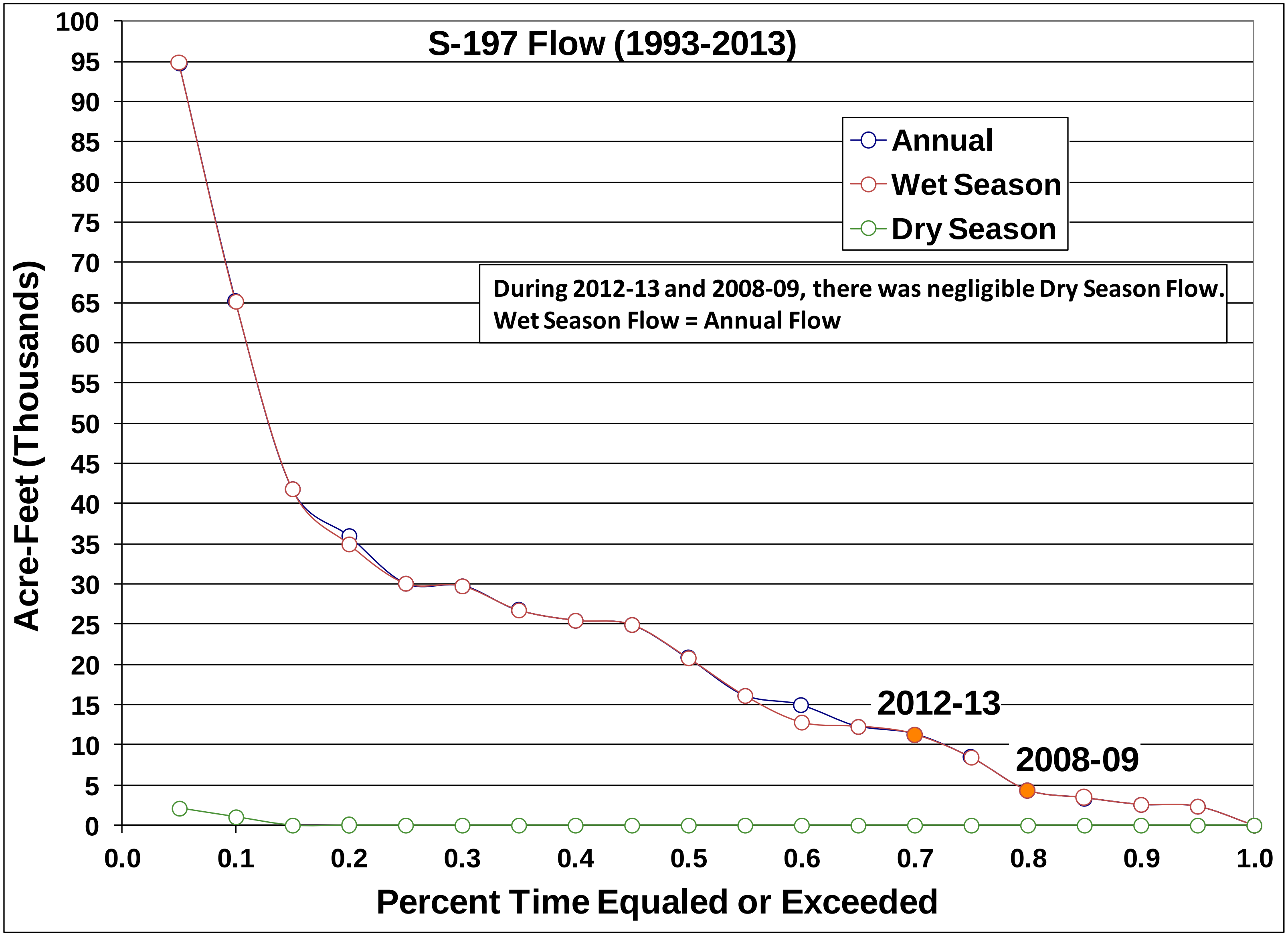
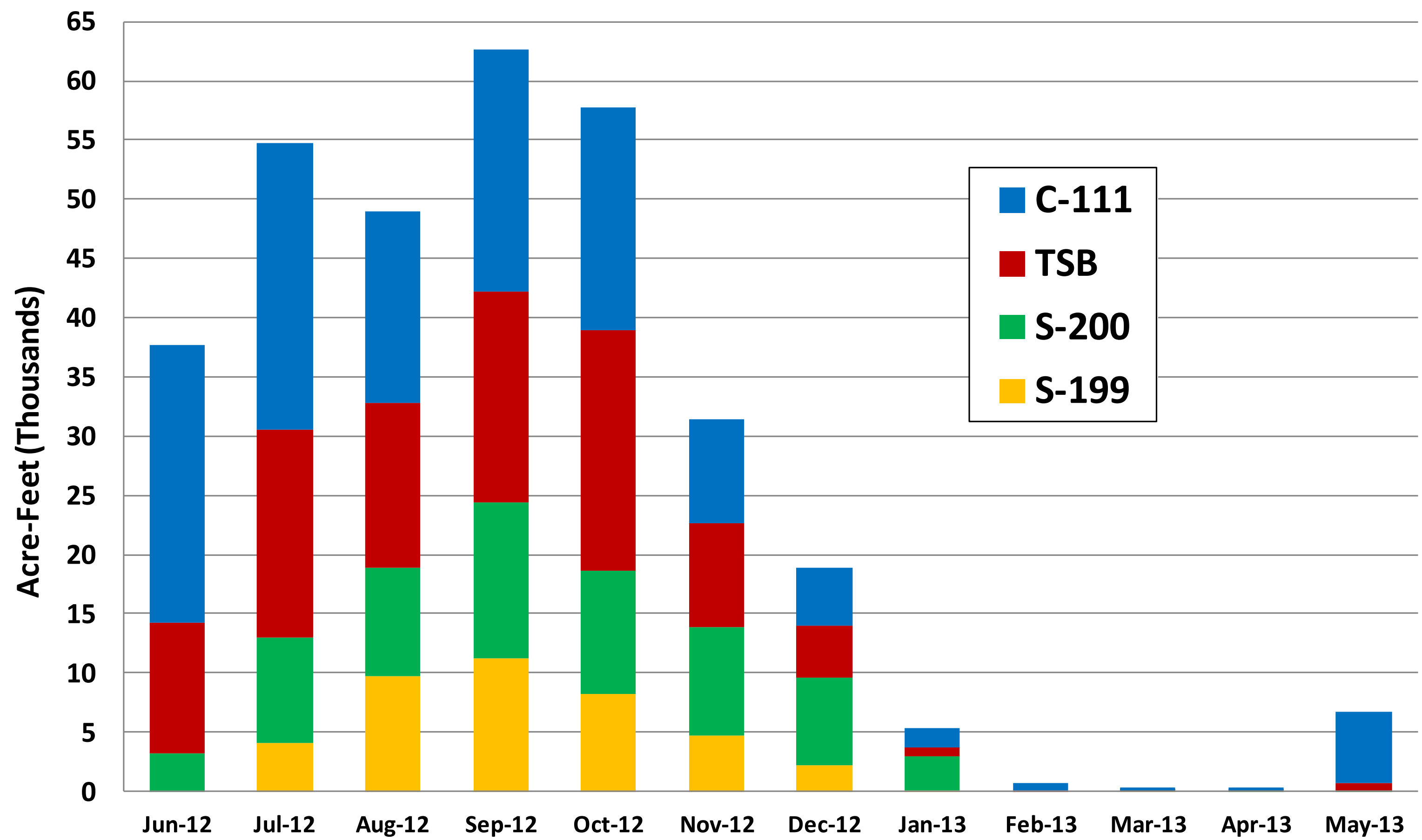


Figure 16. Exceedance curves of annual and seasonal flow through the S-197 structure for the period of record 1993-94 – 2012-13.



	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13
C-111	23.4	24.2	16.1	20.4	18.9	8.7	4.8	1.6	0.7	0.4	0.2	6.1
TSB	11.0	17.6	14.0	17.8	20.3	8.8	4.4	0.8	0.0	0.0	0.0	0.7
S-200	3.3	8.9	9.1	13.1	10.4	9.2	7.5	2.8	0.0	0.0	0.0	0.0
S-199	0.0	4.1	9.7	11.3	8.2	4.7	2.1	0.1	0.0	0.0	0.0	0.0

Figure 17. Total monthly flow volumes discharged through the S-200 and S-199 during 2012-13 in relation to monthly flow at Taylor Slough Bridge and discharge from the C-111 canal.

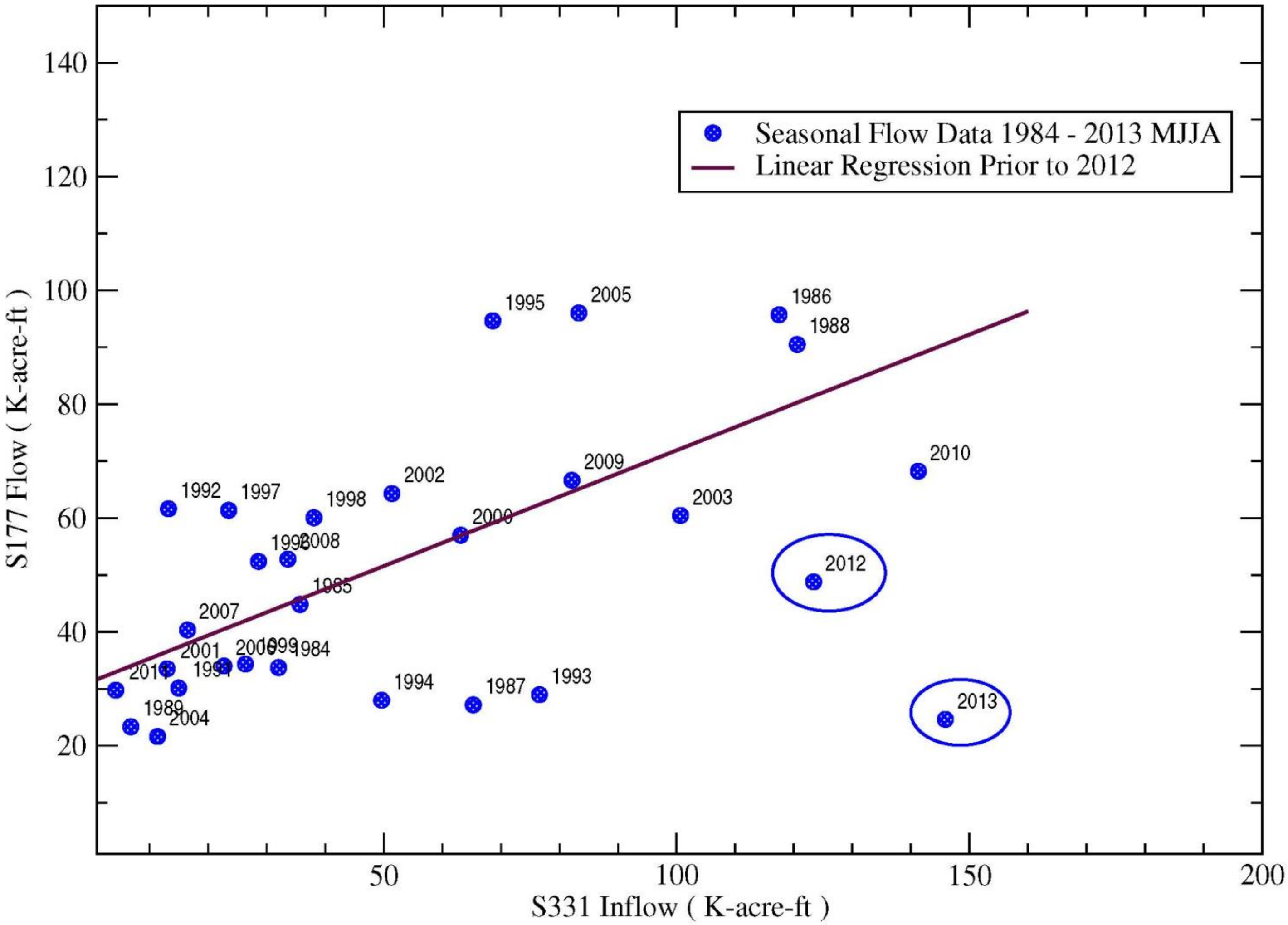


Figure 18. Scatter plot between wet season flow volumes at S-177 and the upstream S-331 for the months May, June, July and August for the period 1984-2013. Data and figure courtesy of Kevin Kotun, Everglades National Park.

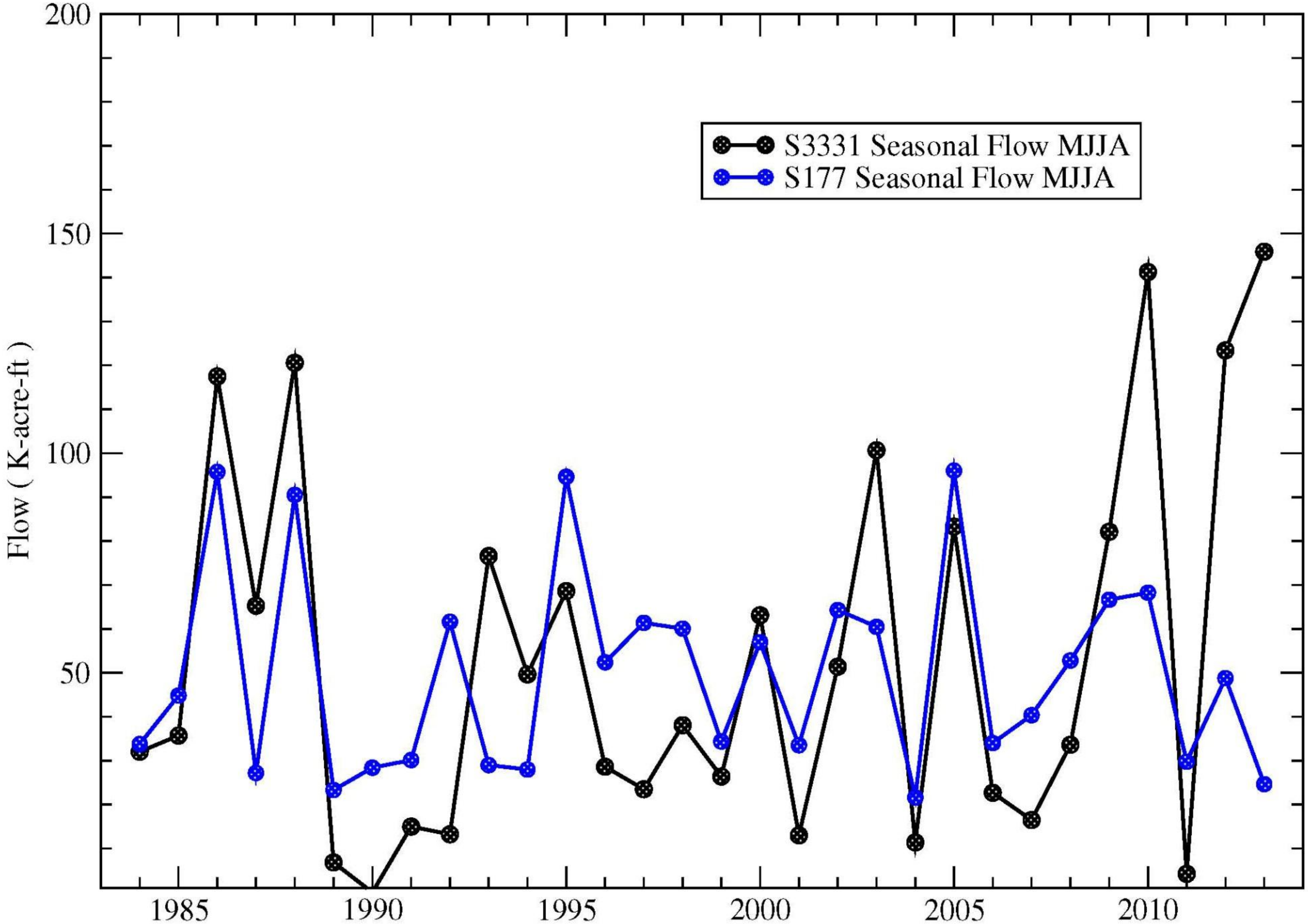


Figure 19. Time series plot of wet season flow volumes at S-177 and the upstream S-331 for the months May, June, July and August for the period 1984-2013. Data and figure courtesy of Kevin Kotun, Everglades National Park.

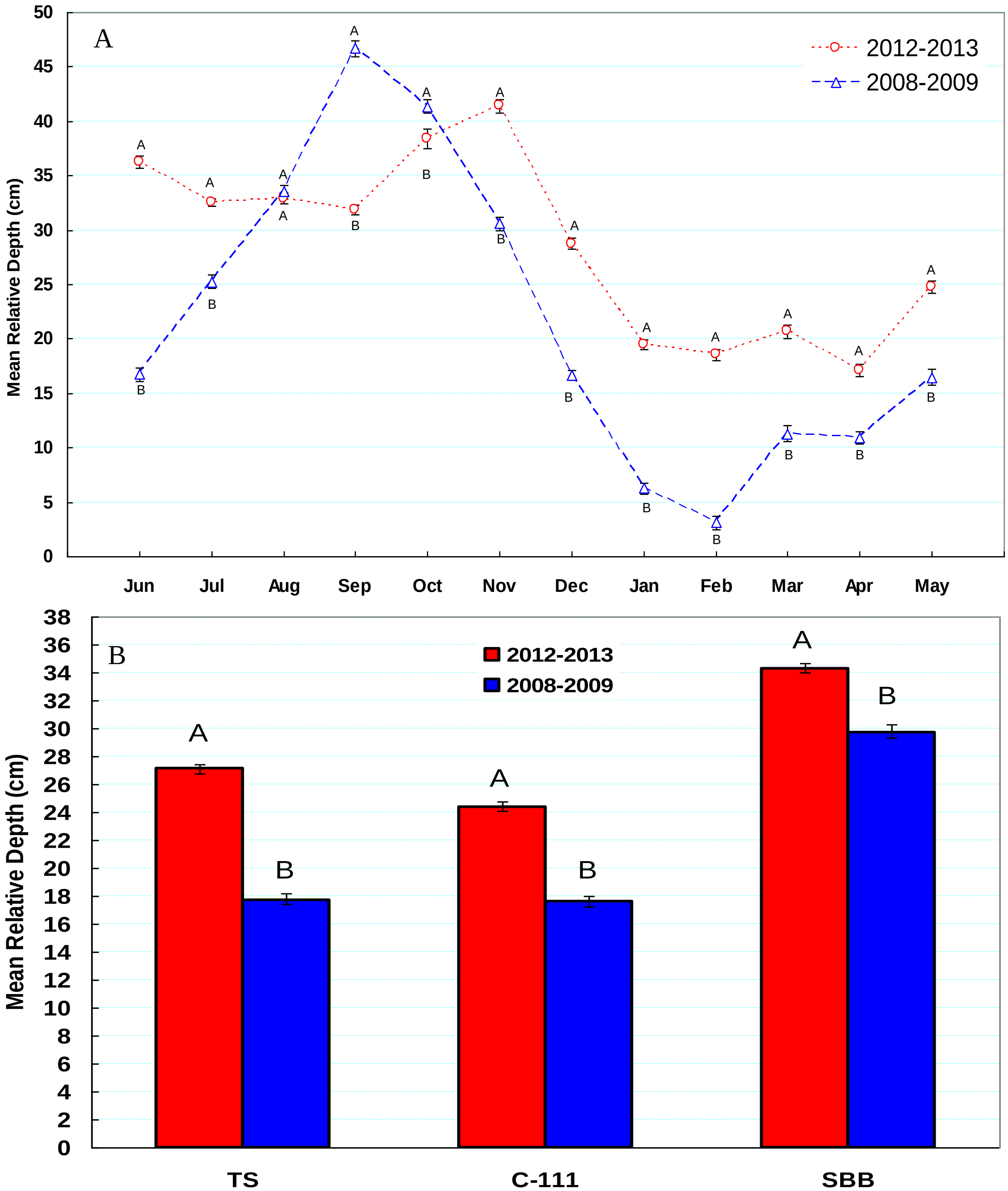


Figure 20. Comparison of mangrove zone mean relative depth (cm) between 2012-2013 and 2008-2009. A. Mean (±SE) monthly depth of three watersheds. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly means for that month. B. Mean (±SE) annual depth in three watersheds. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years at that site.

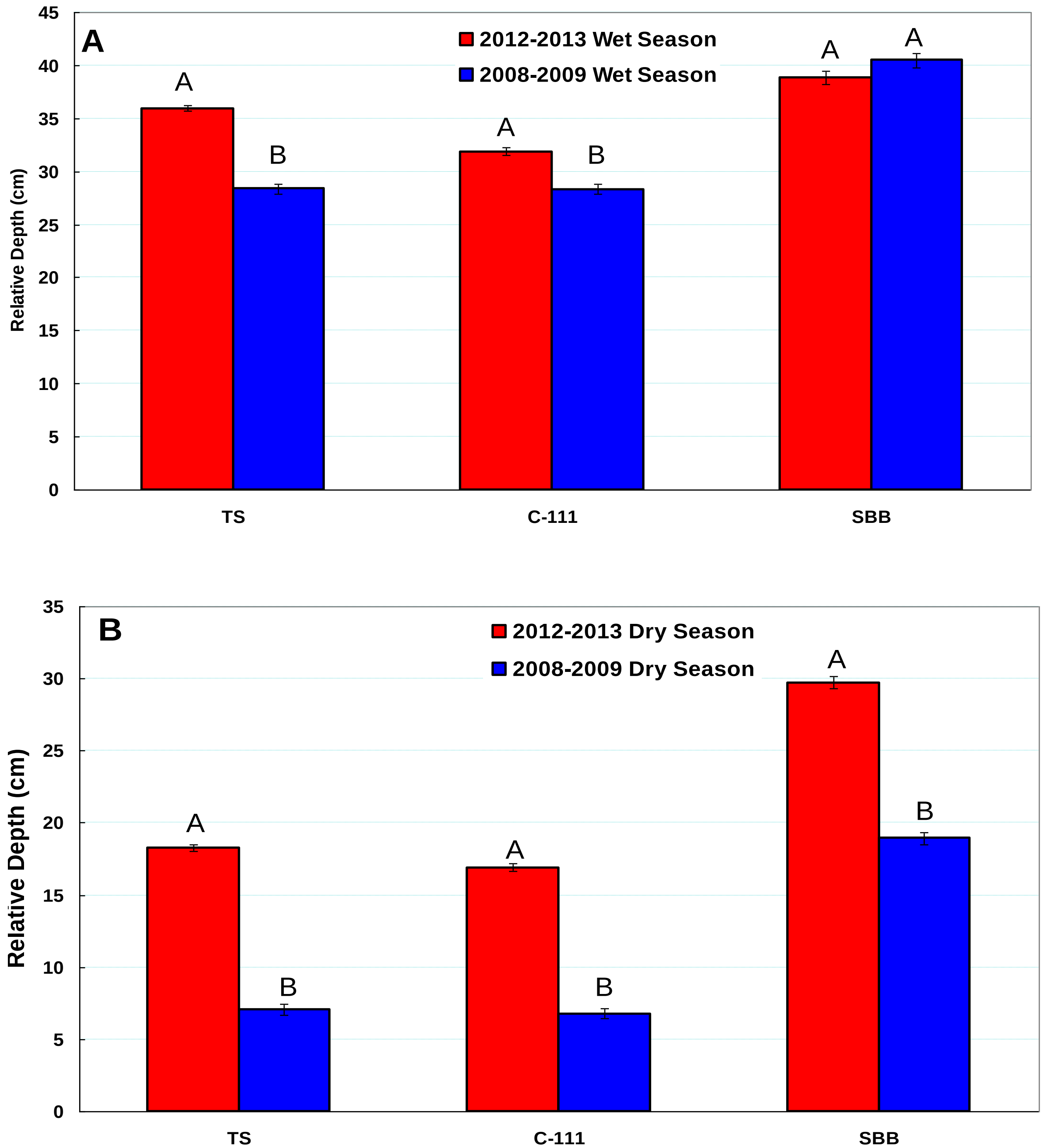


Figure 21. Comparison of mean wet (A) and dry (B) season water levels in three watersheds for the 2012-13 and 2008-09 hydrologic years.

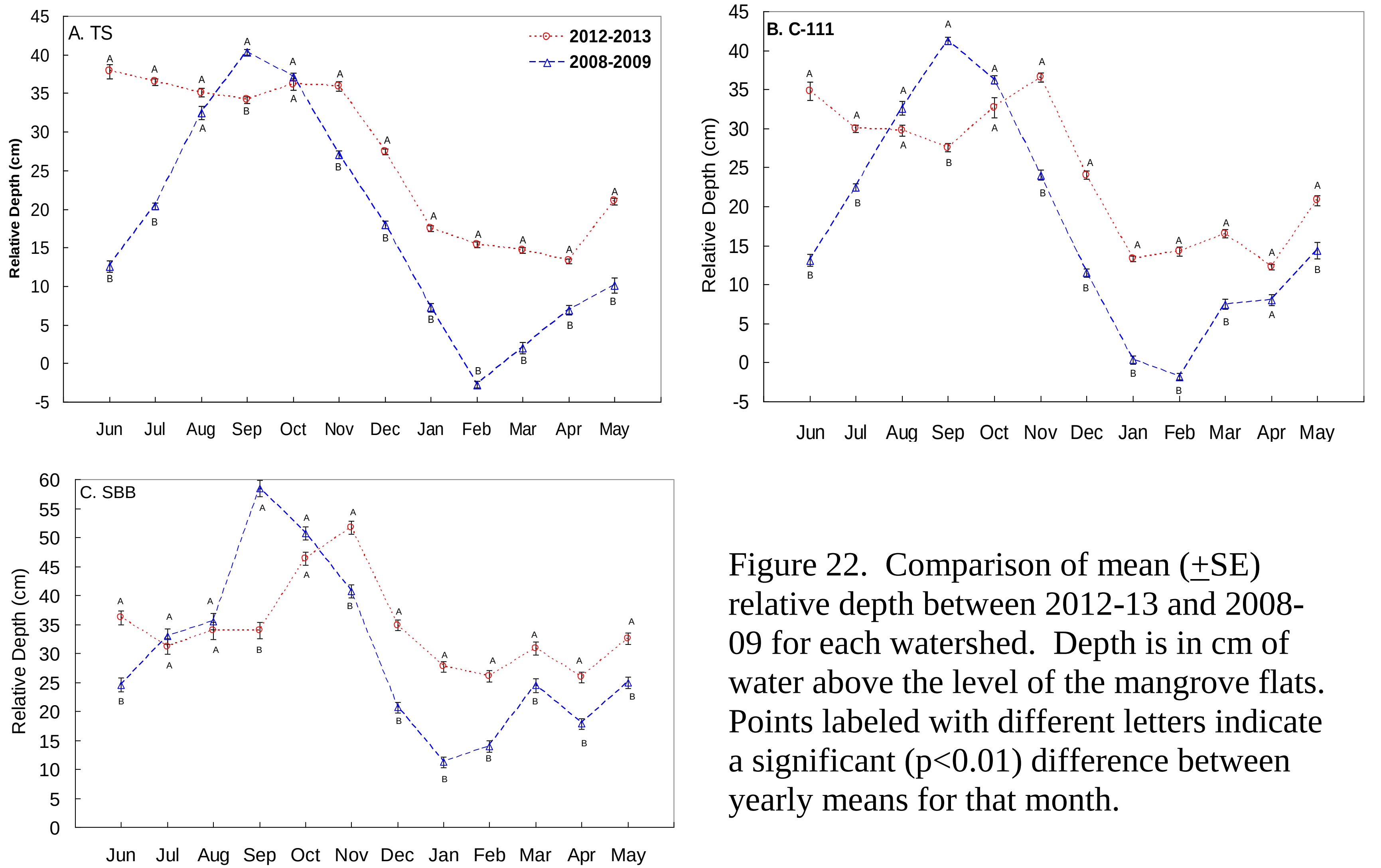
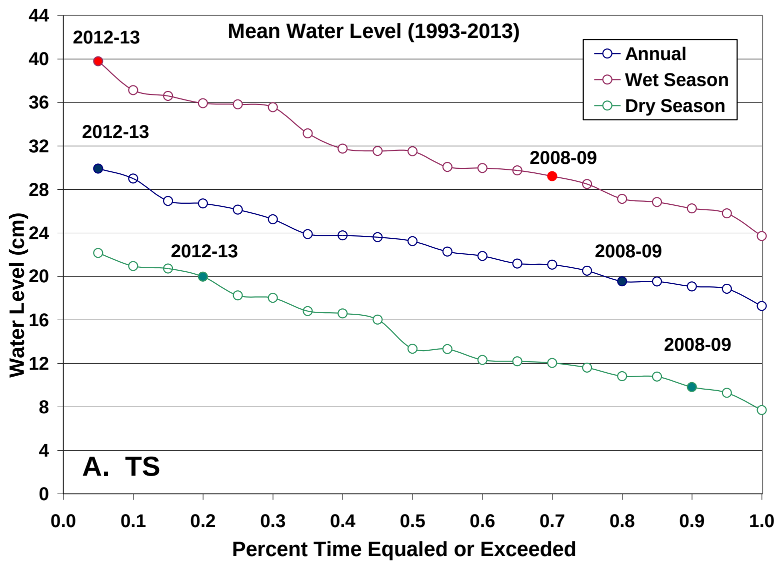
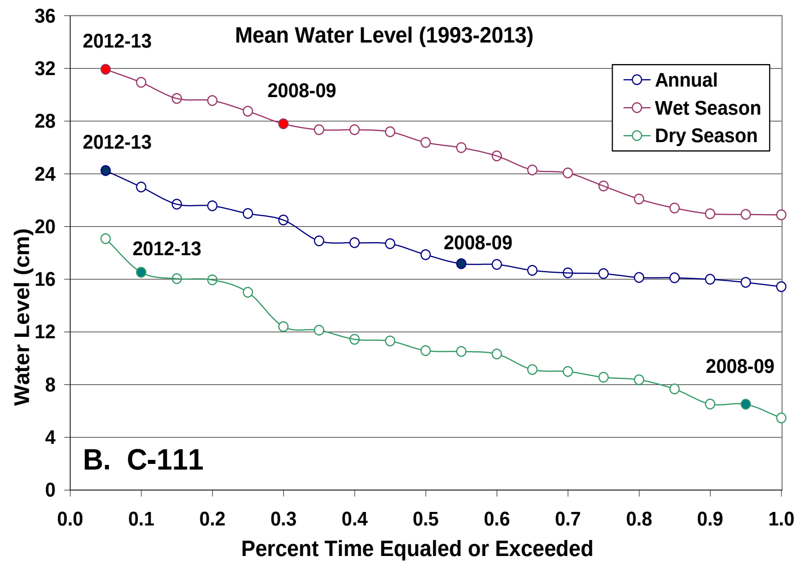


Figure 22. Comparison of mean (±SE) relative depth between 2012-13 and 2008-09 for each watershed. Depth is in cm of water above the level of the mangrove flats. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly means for that month.





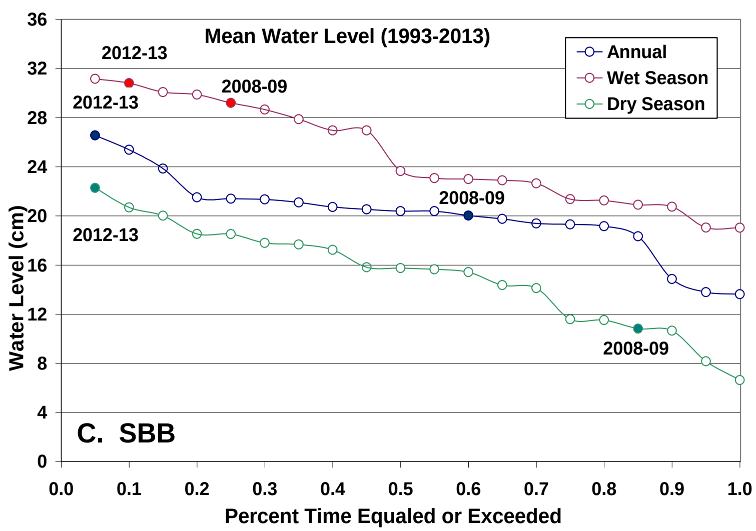
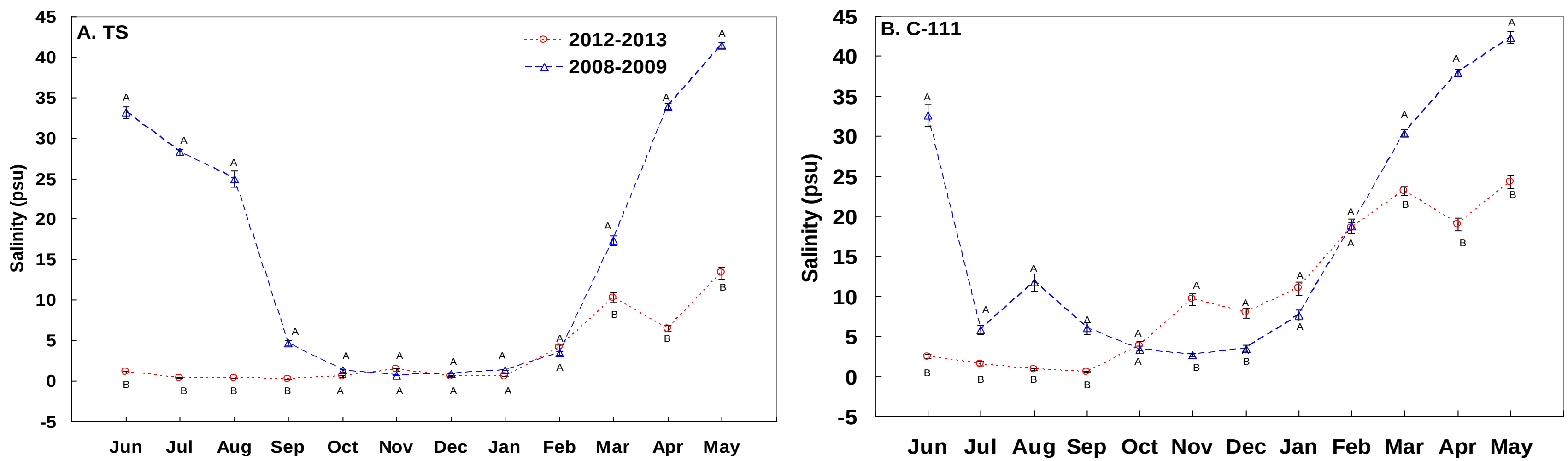


Figure 23. Exceedance curves for water level from three watersheds for the period of record 1993-2013. The three watersheds represented are: A. Taylor Slough, B. C-111, and C. Southern Biscayne Bay. Only sites with data spanning the period of record were used to develop the exceedance curves. TS includes the Taylor River site only. C-111 includes both the Joe Bay and Highway Creek sites. SBB includes the Barnes Sound site only.



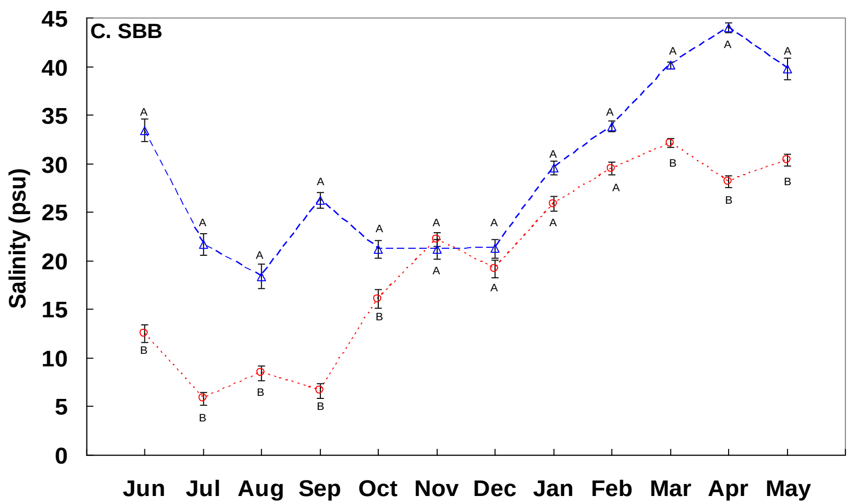
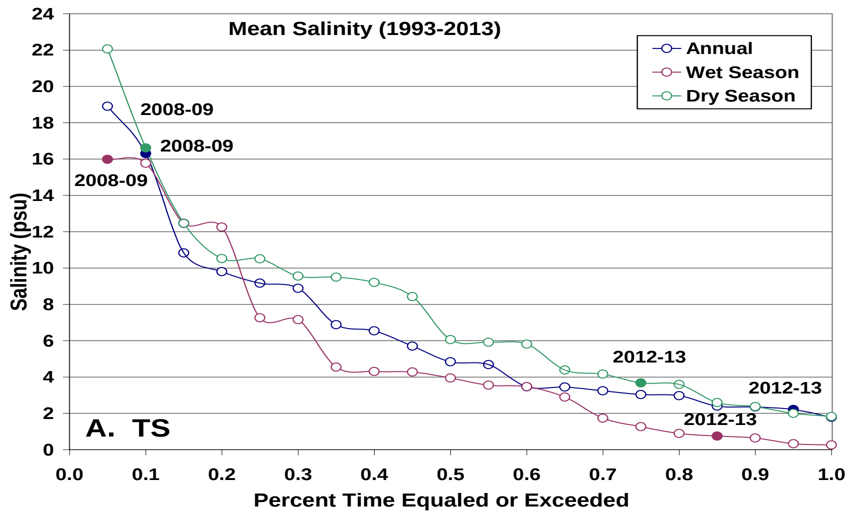
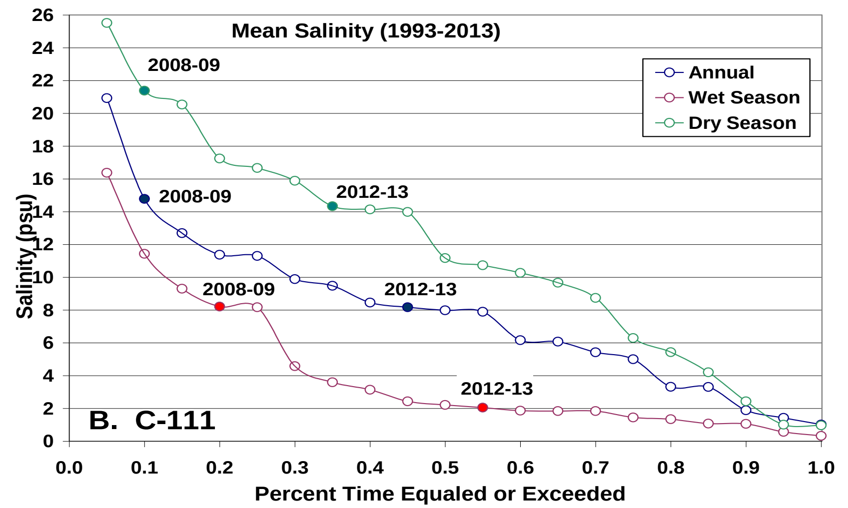


Figure 24. Comparison of mean (±SE) salinity (psu) between 2012-13 and 2008-09 for each watershed. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly means for that month.





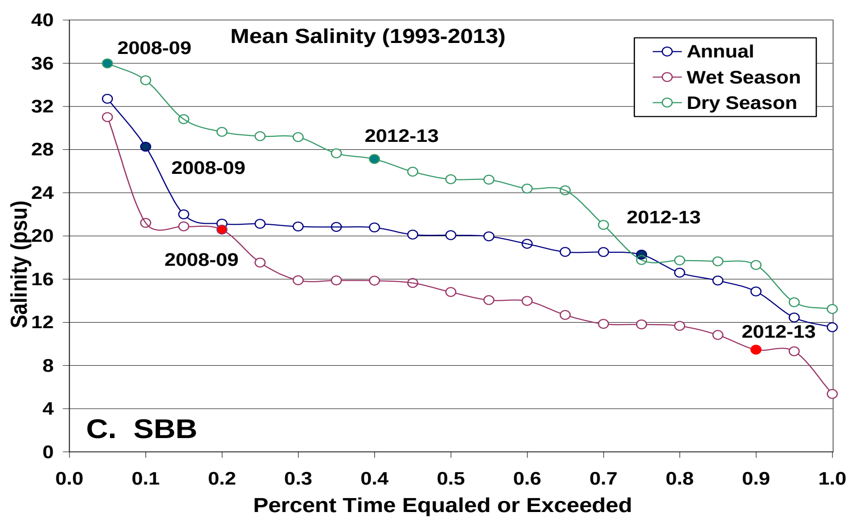


Figure 25. Exceedance curves for salinity from three watersheds for the period of record 1993-2013. The three watersheds represented are: A. Taylor Slough, B. C-111, and C. Southern Biscayne Bay. Only sites with data spanning the period of record were used to develop the exceedance curves. TS includes the Taylor River site only. C-111 includes both the Joe Bay and Highway Creek sites. SBB includes the Barnes Sound site only.

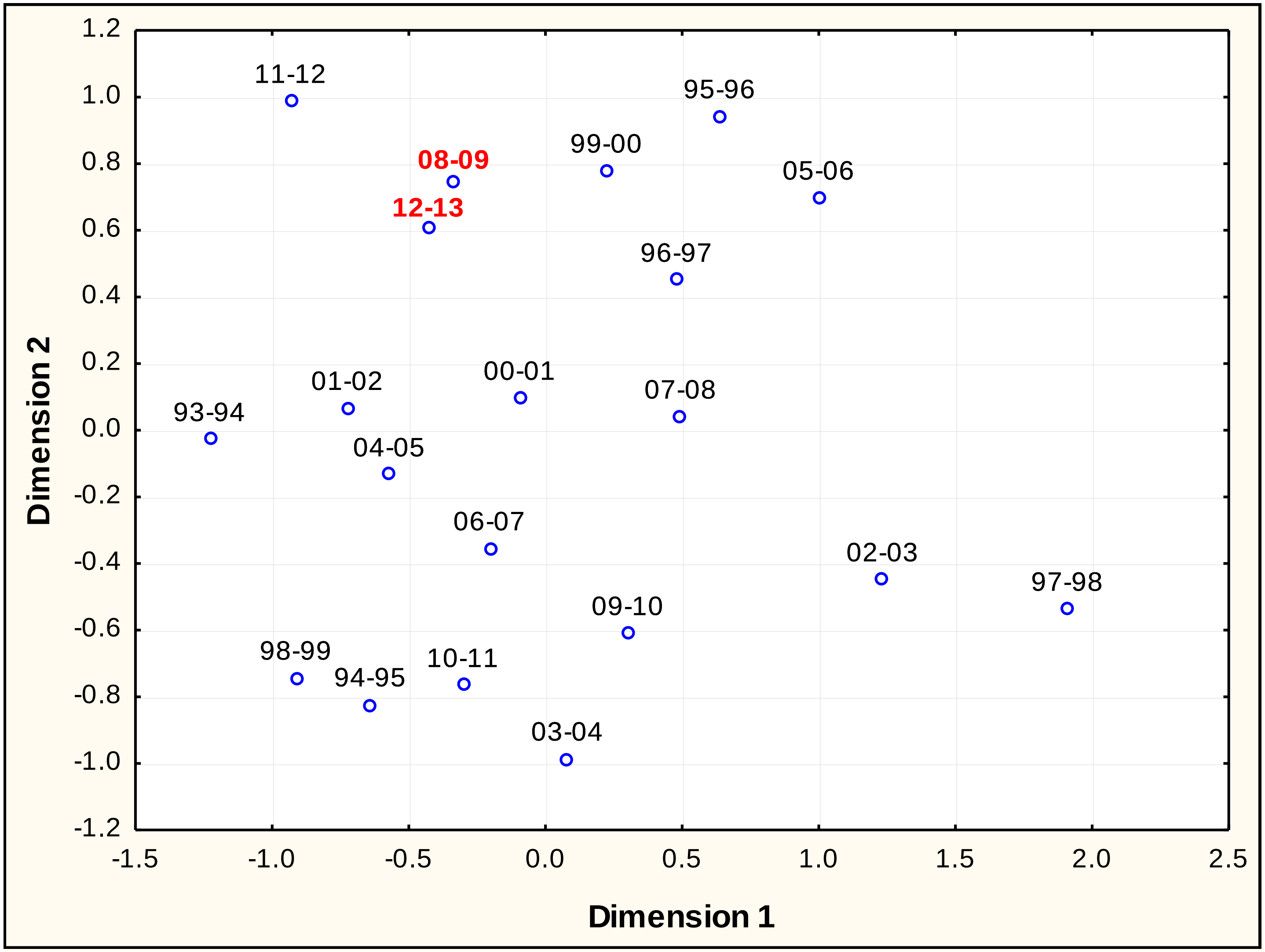


Figure 26. NMDS plot of ordination scores from mean monthly rainfall by hydrologic year for the 20 year period 1993-94 – 2012-13 from 29 rain collection locations in the local watershed. Subject and comparison years are highlighted in red.

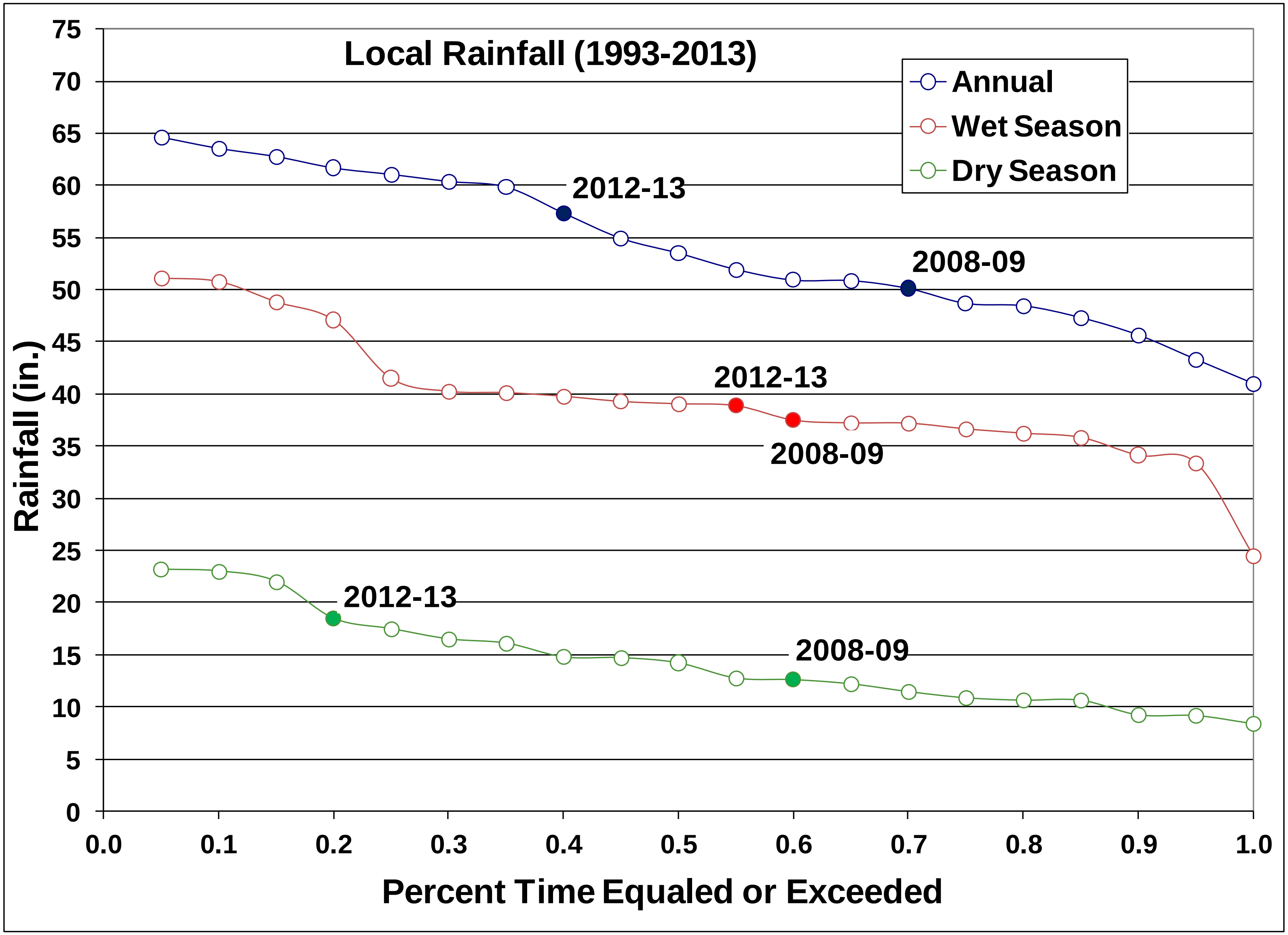


Figure 27. Exceedance curves of annual and seasonal rainfall for the local watershed for the period of record 1993-94 – 2012-13.

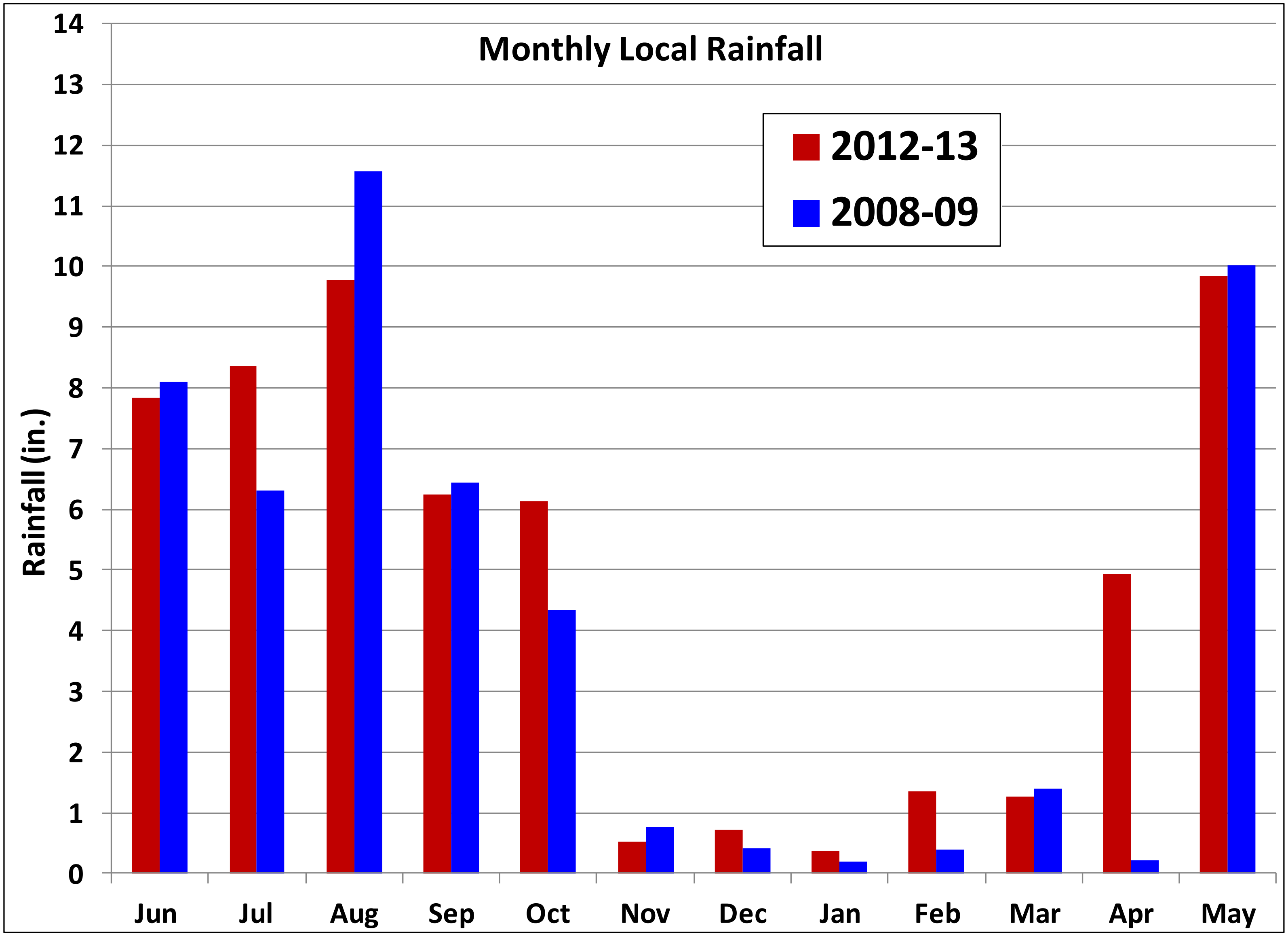


Figure 28. Comparison of monthly rainfall sums between 2012-13 and 2008-09 for the local watershed.

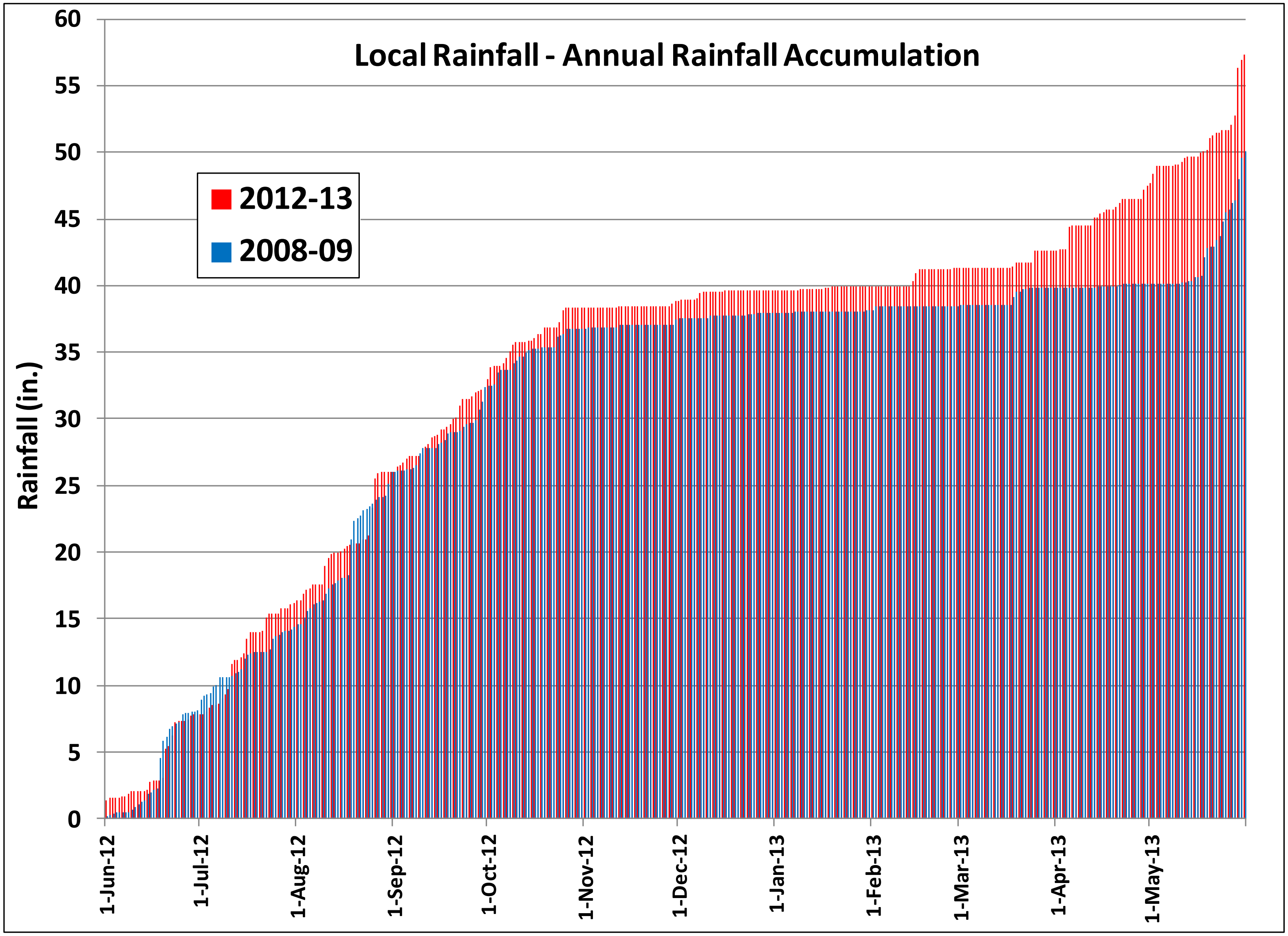


Figure 29. Annual rainfall accumulation during 2012-13 and 2008-09 for the local watershed

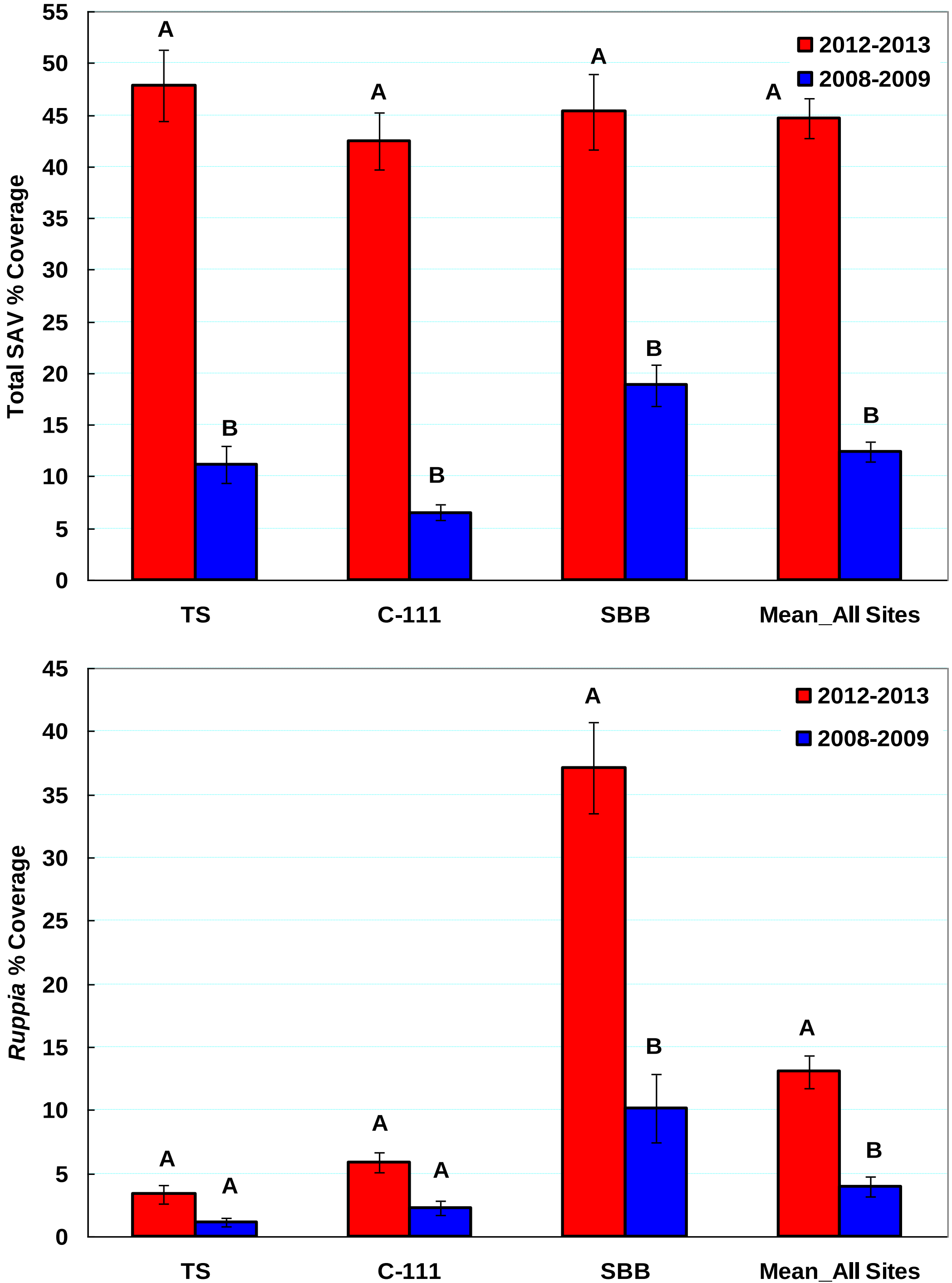


Figure 30. Mean (± SE) total SAV coverage (top panel) and *Ruppia* coverage (bottom panel) on an annual basis for each watershed. Only sites within the watersheds with periods of record beginning prior to June 2008 were included: TR1 in TS, JB1 and HC1A in C-111, and BS1 and MB1 in SBB.site only. CS1 was not used in SBB because the site is not in the creek where the fish sample occurs, but is located downstream in an open lake habitat. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years.

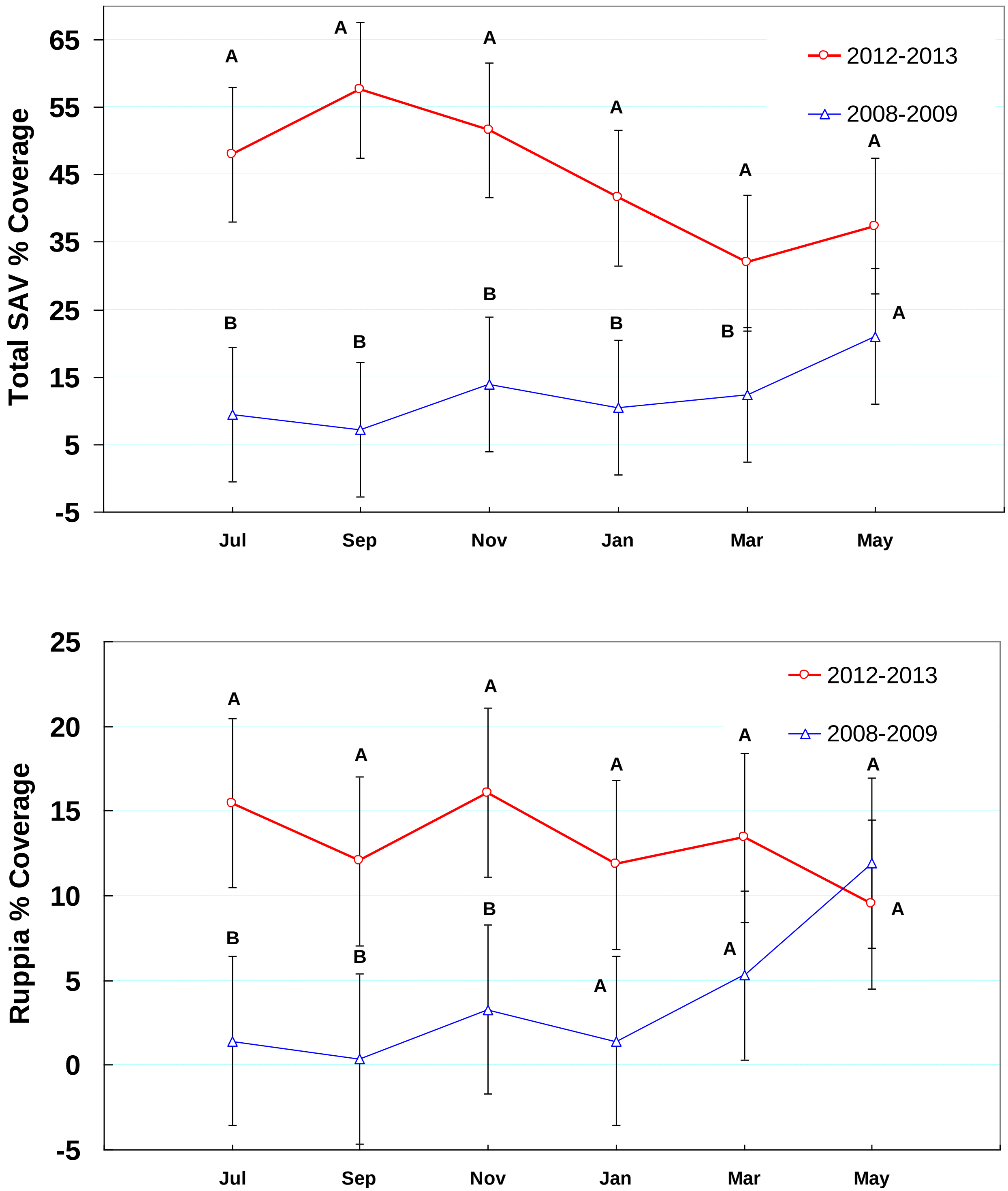


Figure 31. Mean (± SE) total SAV coverage (top panel) and *Ruppia* coverage (bottom panel) on a monthly basis. Data from all three watersheds are combined. Points labeled with different letters indicate a significant ($p<0.01$) difference between years.

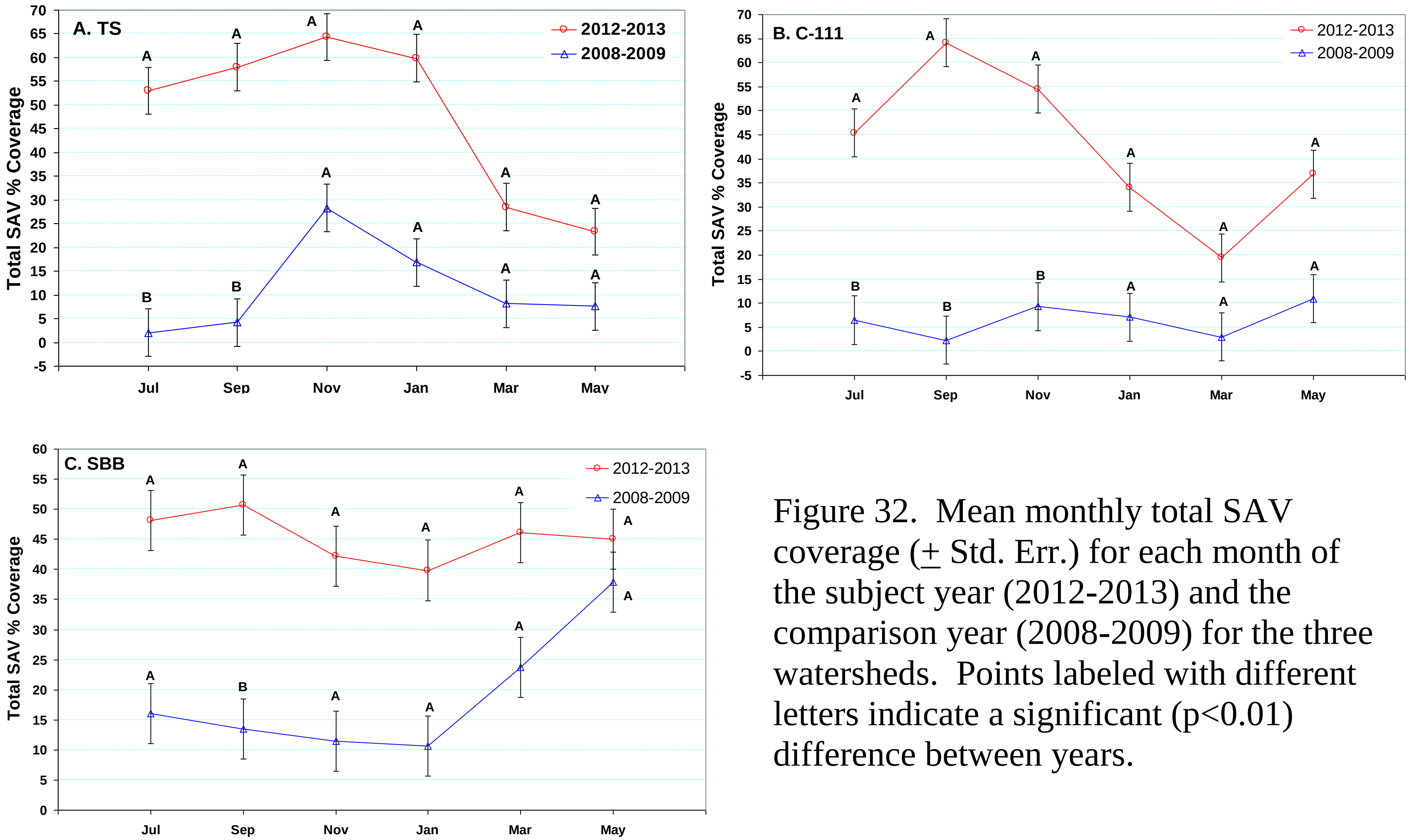
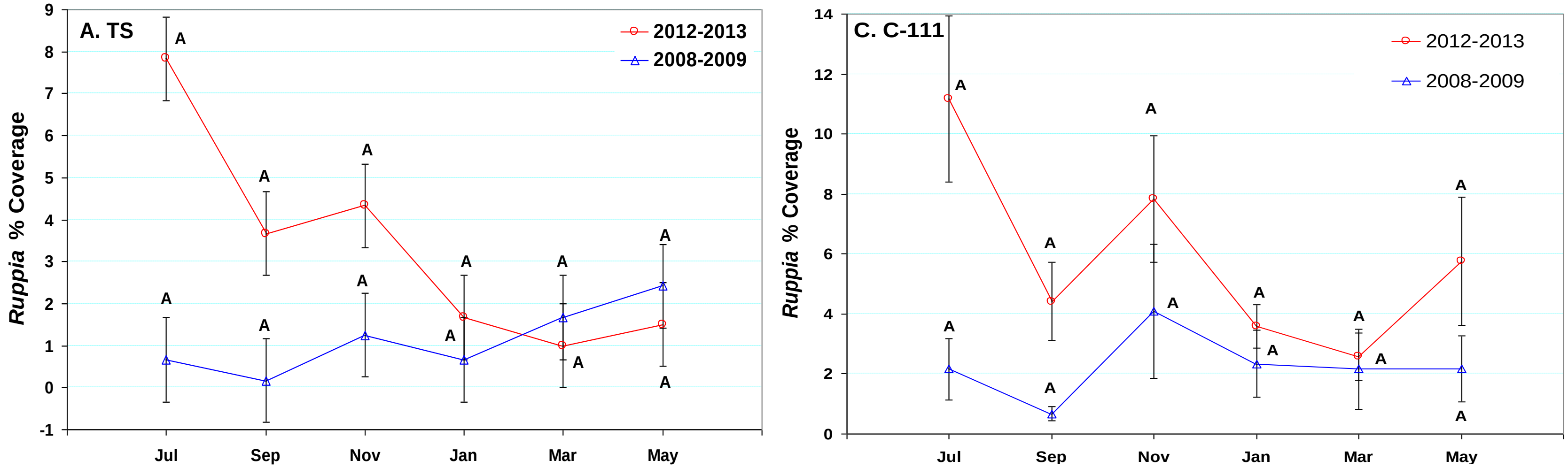


Figure 32. Mean monthly total SAV coverage (± Std. Err.) for each month of the subject year (2012-2013) and the comparison year (2008-2009) for the three watersheds. Points labeled with different letters indicate a significant (p<0.01) difference between years.



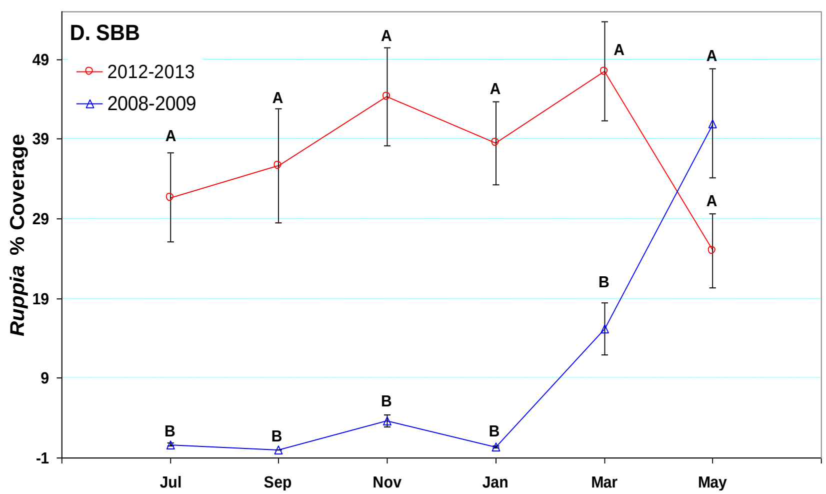


Figure 33. Mean monthly *Ruppia* coverage (± Std. Err.) for each month of the subject year (2012-2013) and comparison year (2008-2009) for the three watersheds. Points labeled with different letters indicate a significant (p<0.01) difference between years.

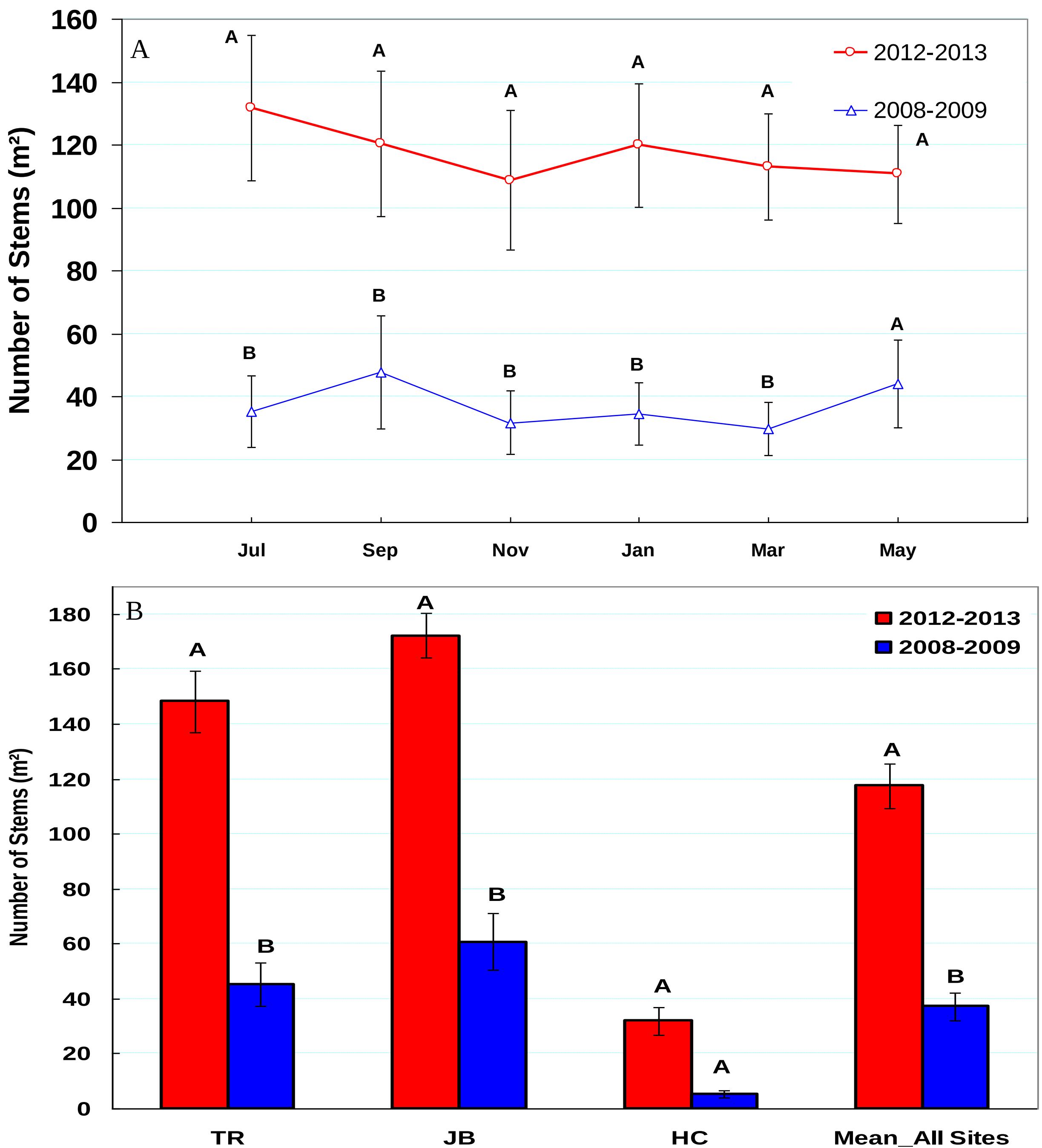


Figure 34. Comparison of Mean (± SE) number of stems (m^2) of emergent vegetation between 2012-13 and 2008-09. A. On a monthly basis combining three sample sites. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly number of stems for that month. B. On a yearly basis for the three sites individually. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years at that site

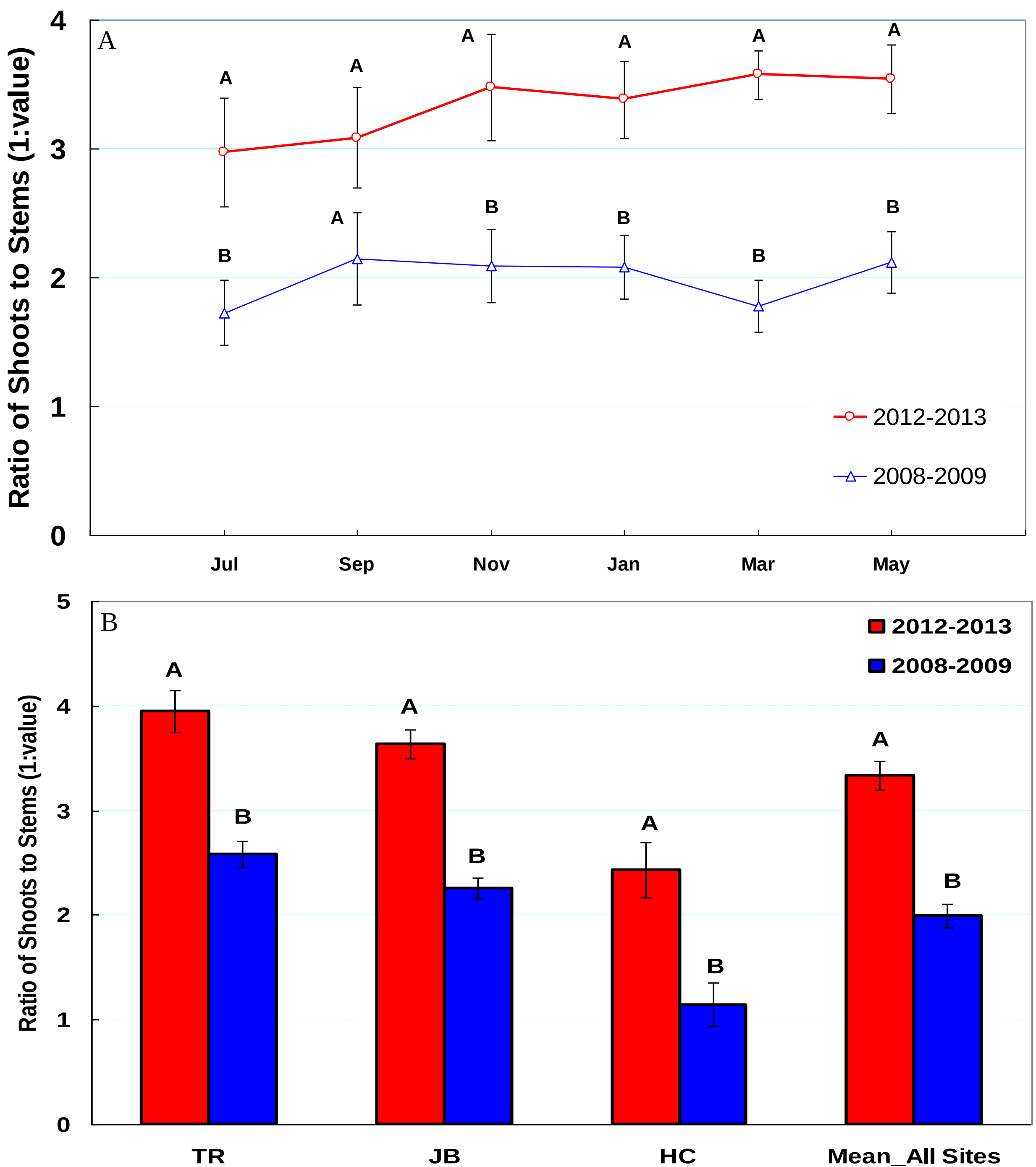


Figure 35. Comparison of Mean (± SE) Ratio of Shoots to Stems of emergent vegetation between 2012-13 and 2008-09. A. On a monthly basis combining three sample sites. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly ratio of shoots to stems for that month. B. On a yearly basis for the three sites individually. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years at that site.

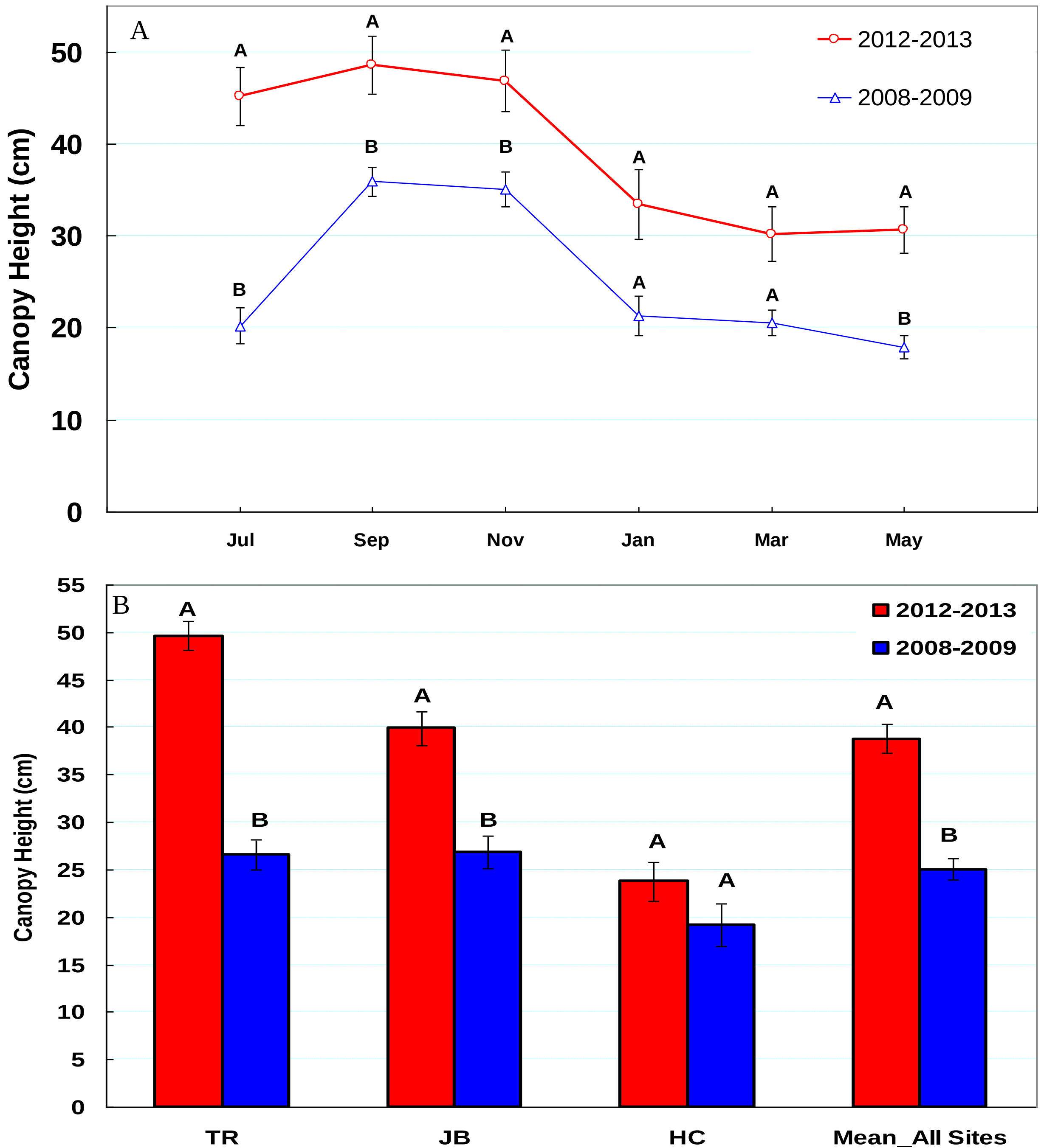


Figure 36. Comparison of Mean (± SE) canopy height of emergent vegetation between 2012-13 and 2008-09. A. On a monthly basis combining three sample sites. Points labeled with different letters indicate a significant ($p<0.01$) difference between yearly canopy height for that month. B. On a yearly basis for the three sites individually. Columns labeled with different letters indicate a significant ($p<0.01$) difference between years at that site.

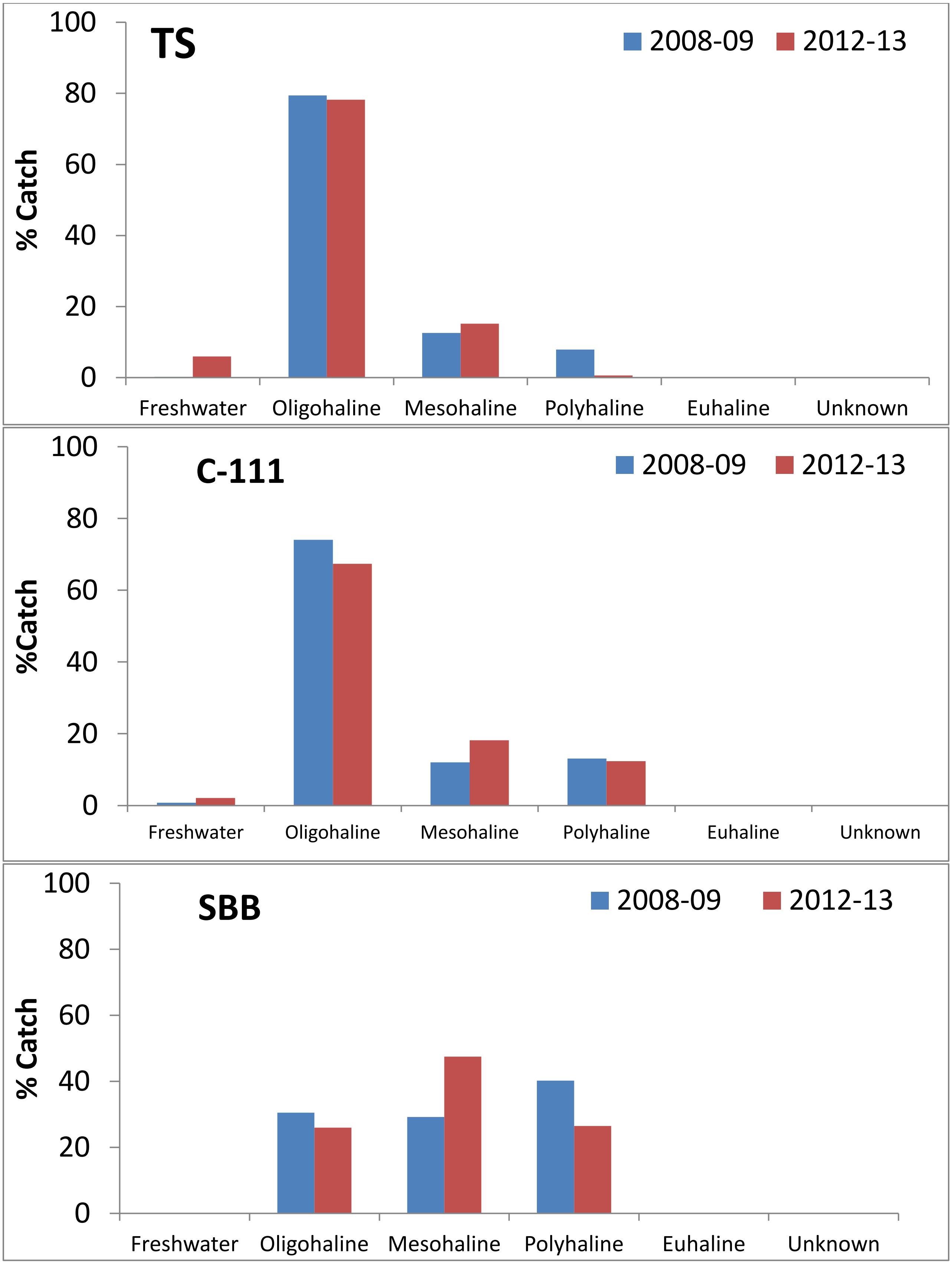


Figure 37. The percentage of the fish community grouped by salinity regime, during 2 hydrologic years in the SBB (A) TS, (B) C-111 and (C) SBB watersheds. Species were grouped by their salinity affinity based on the Venice System of Estuarine Classification.

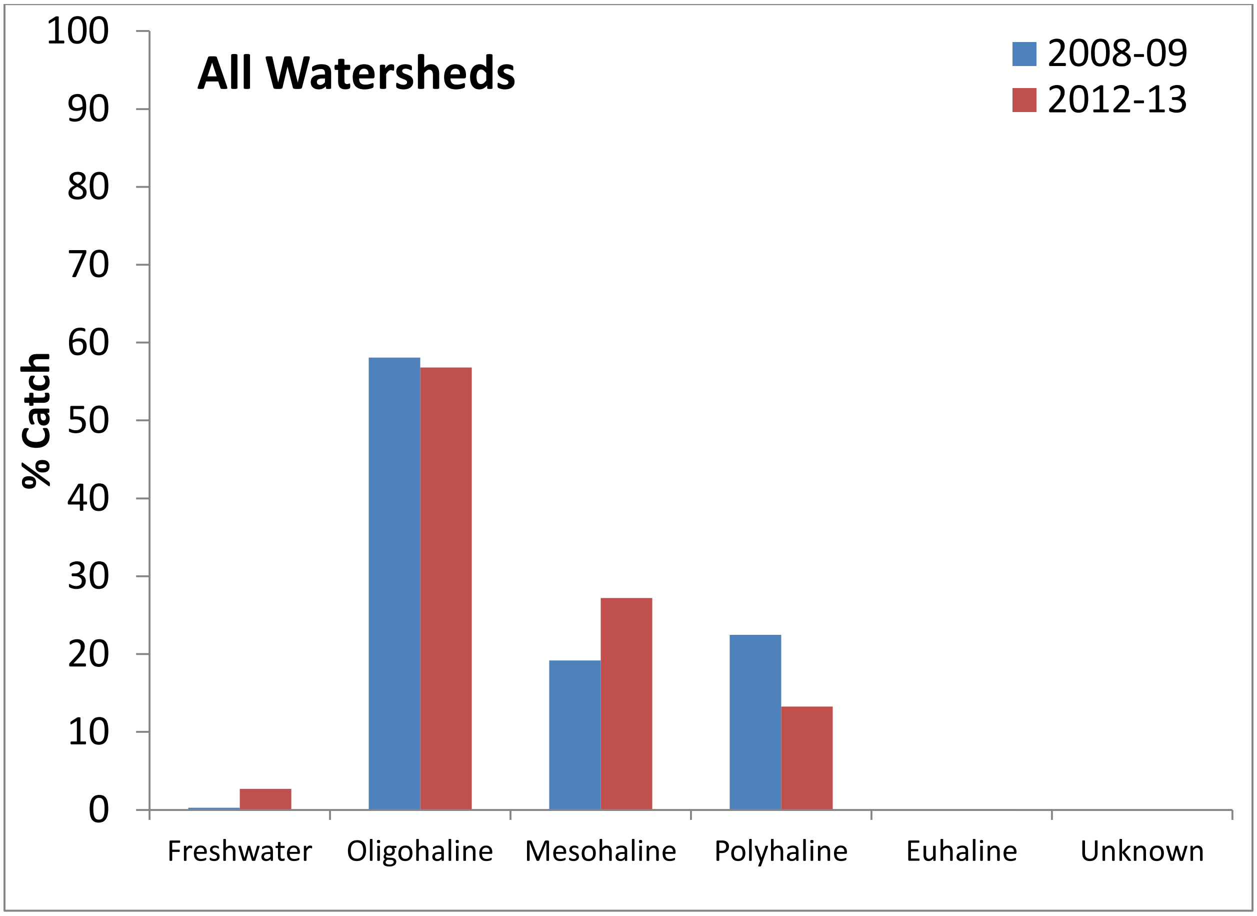


Figure 38. The combined annual percent catch for all four prey base fish sample sites (TR, JB, HC, and BS) grouped by a species salinity affinity based on the Venice System of Estuarine Classification.

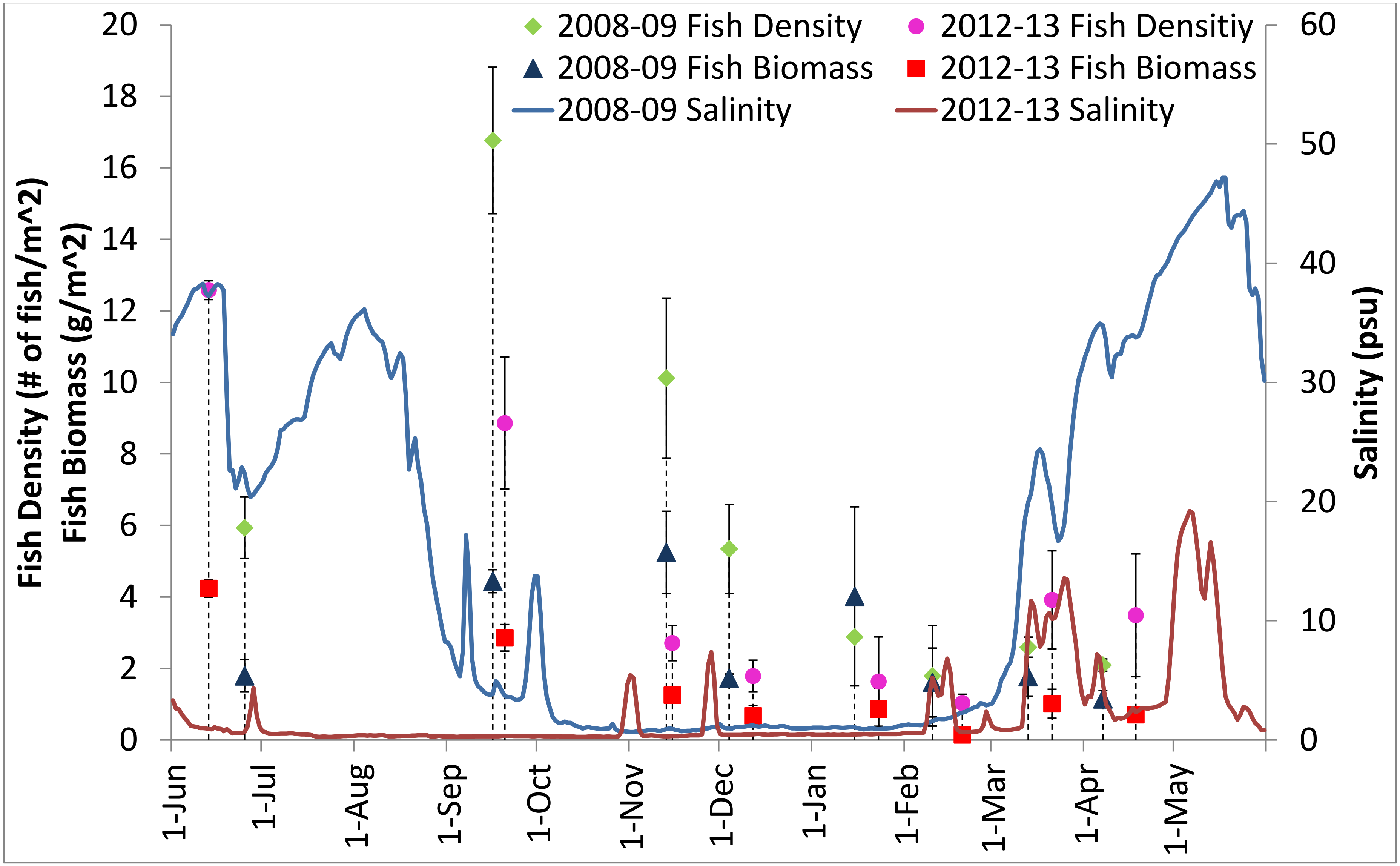


Figure 39. Environmental conditions found at TR during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

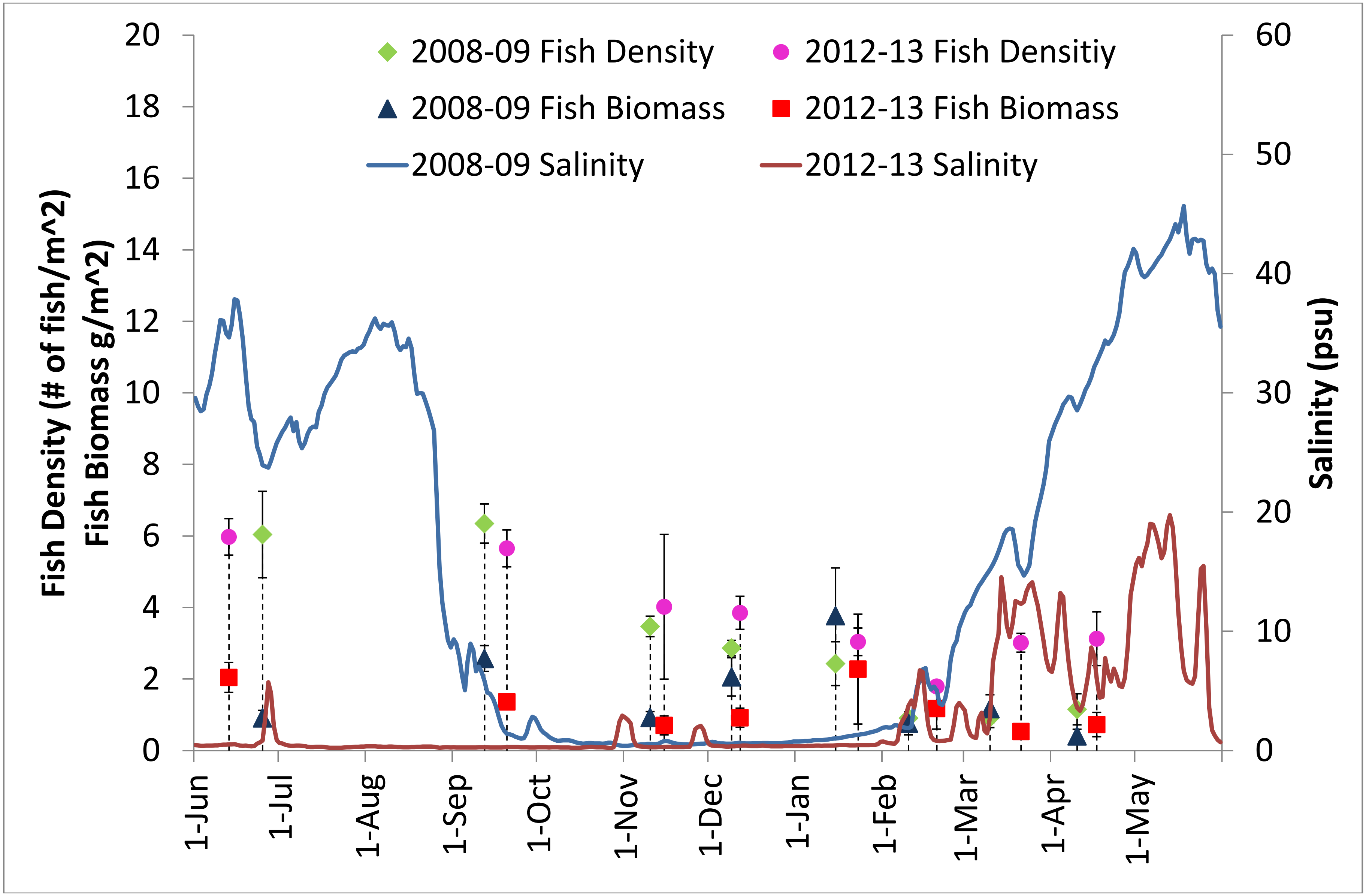


Figure 40. Environmental conditions found at EC, located in the TS Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

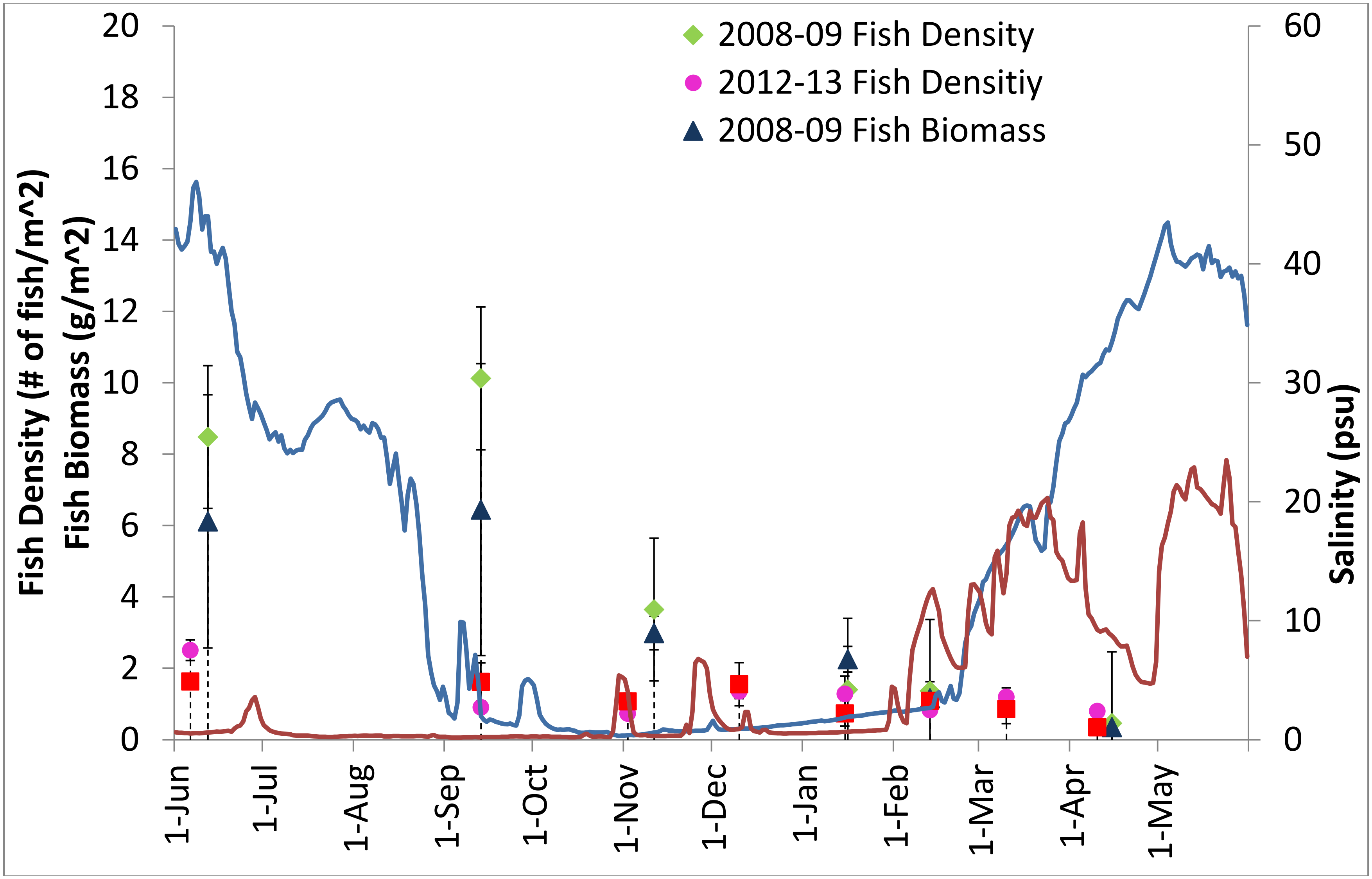


Figure 41. Environmental conditions found at WJ, located in the TS Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

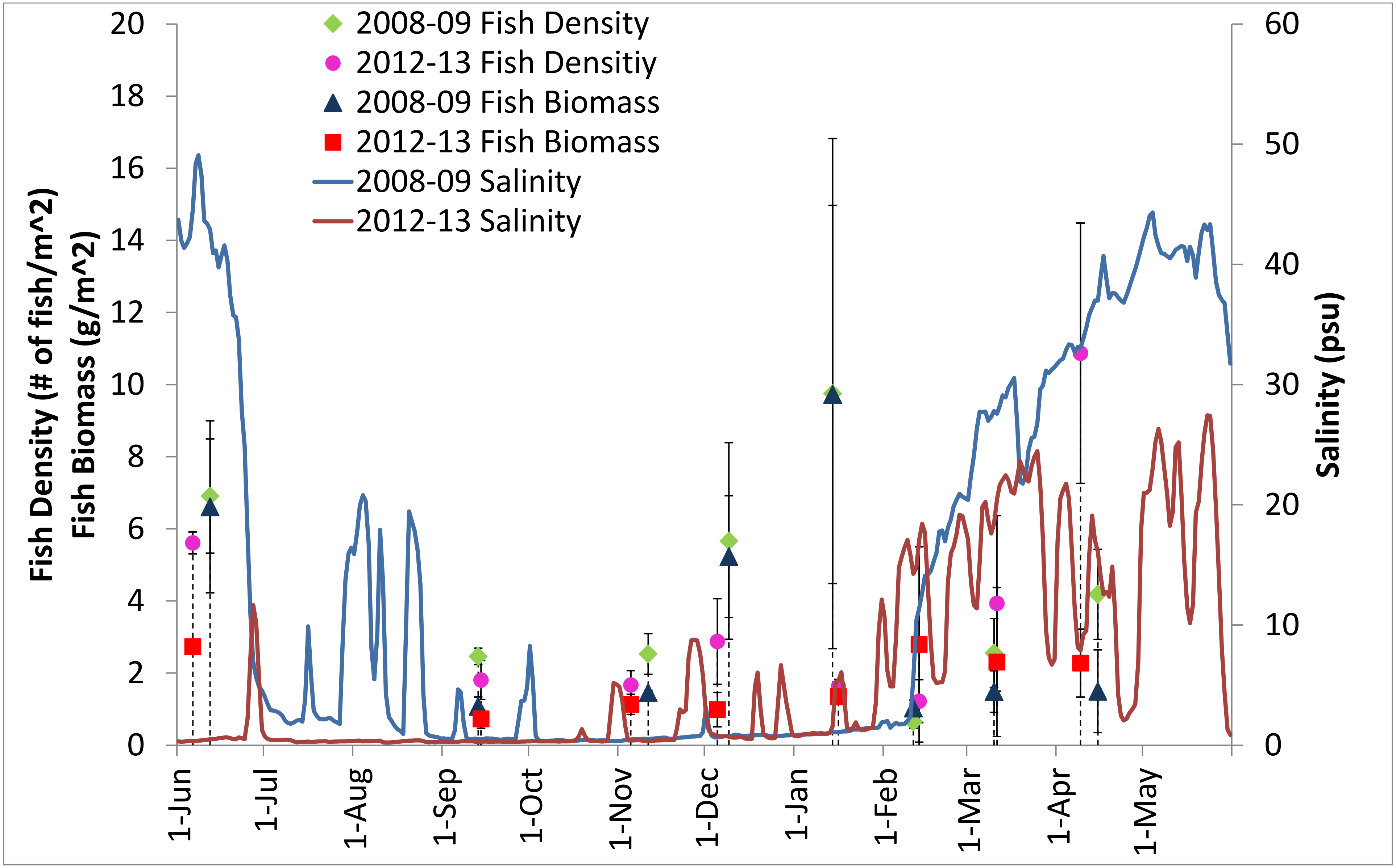


Figure 42. Environmental conditions found at JB, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

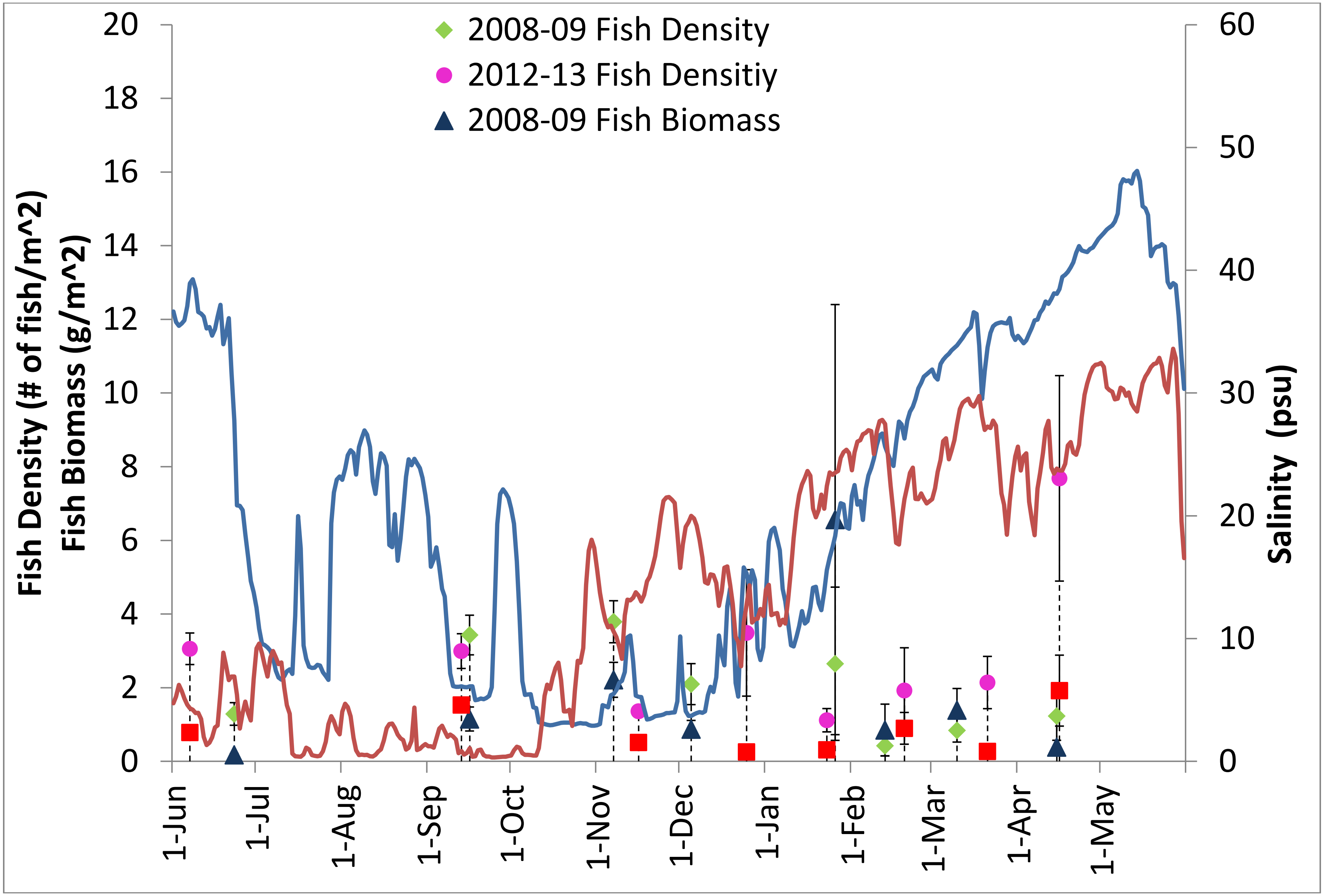


Figure 43. Environmental conditions found at SB, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

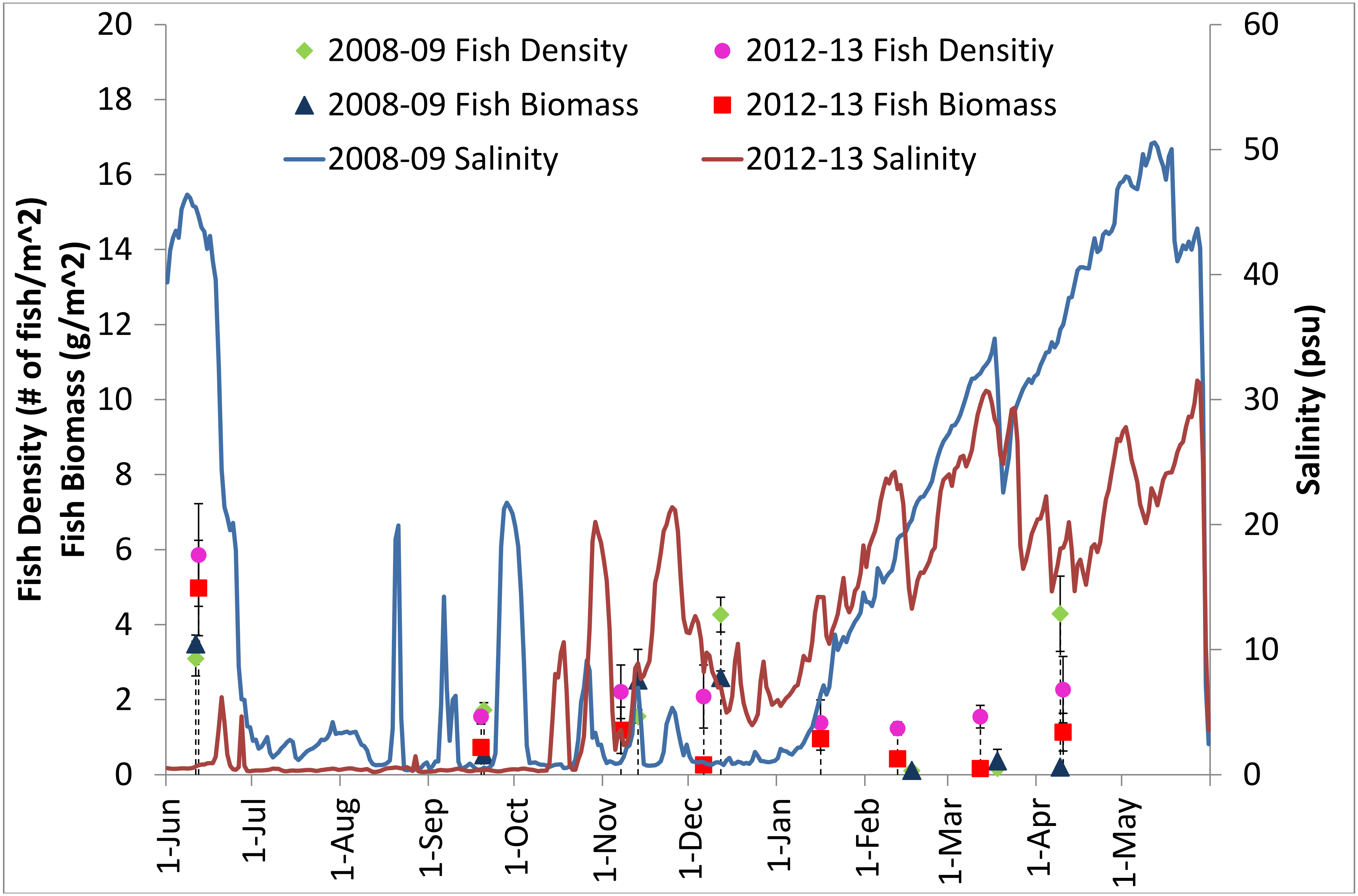


Figure 44. Environmental conditions found at HC, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

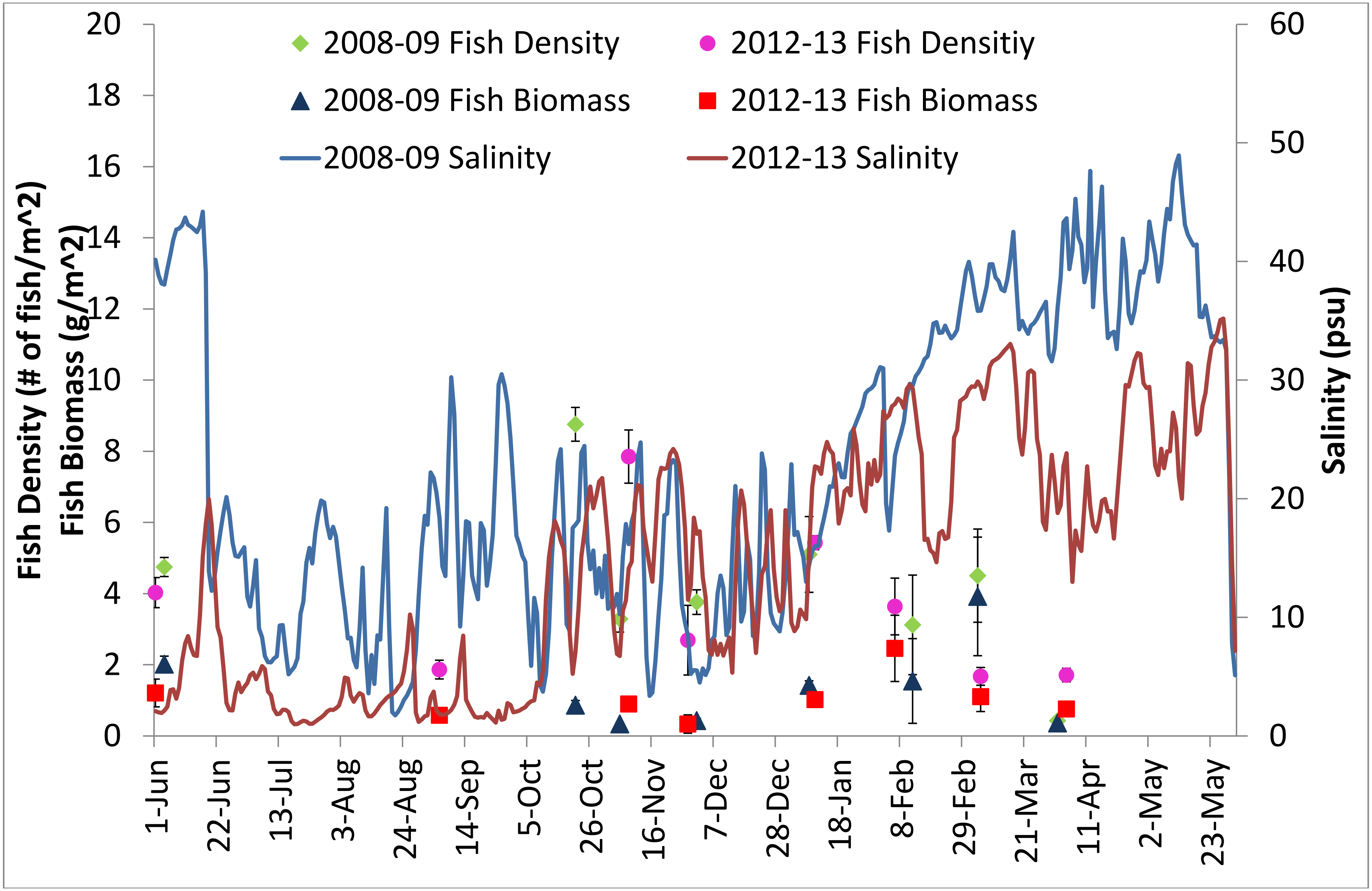


Figure 45. Environmental conditions found at MB, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

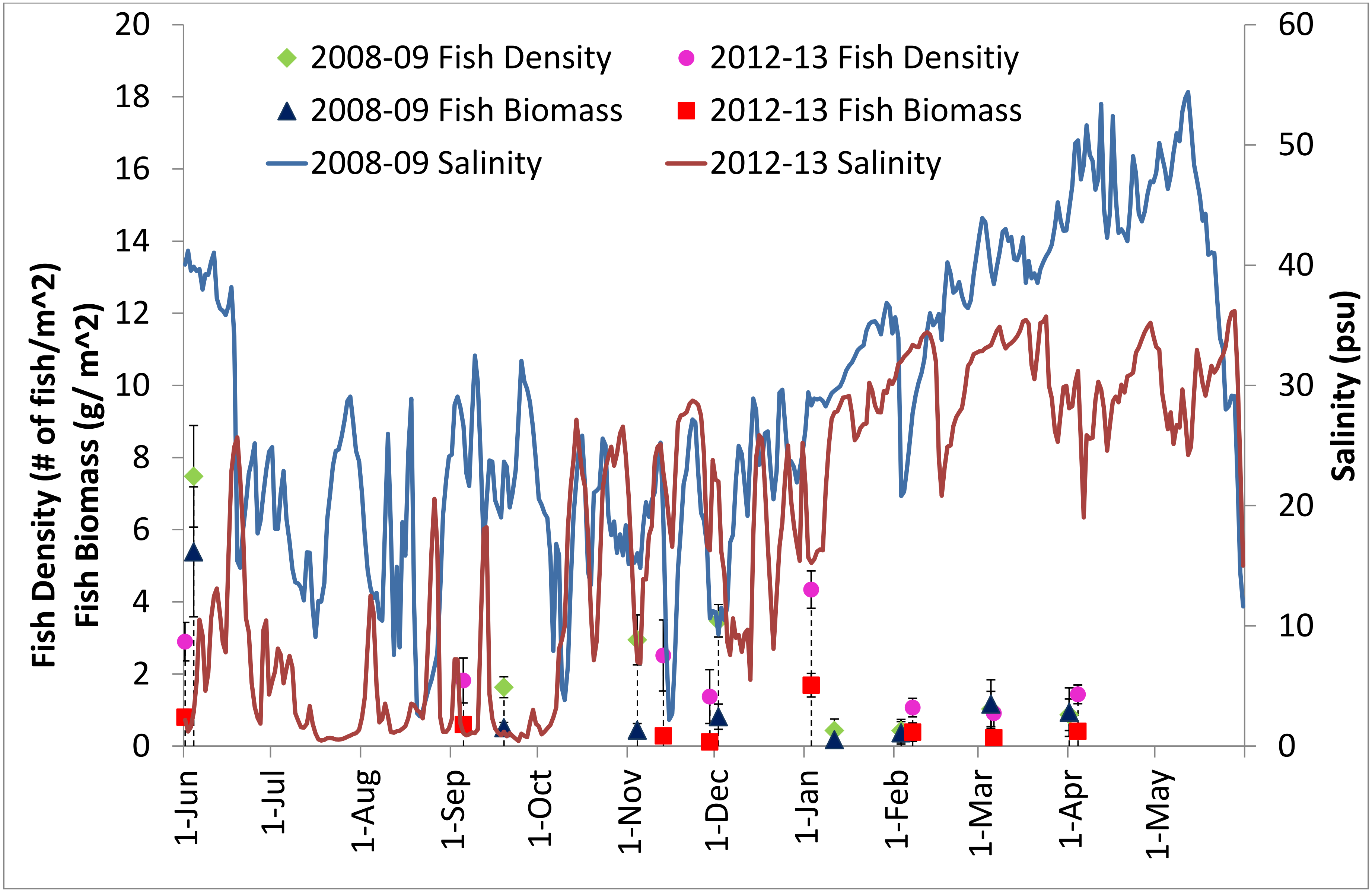


Figure 46. Environmental conditions found at BS, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis).

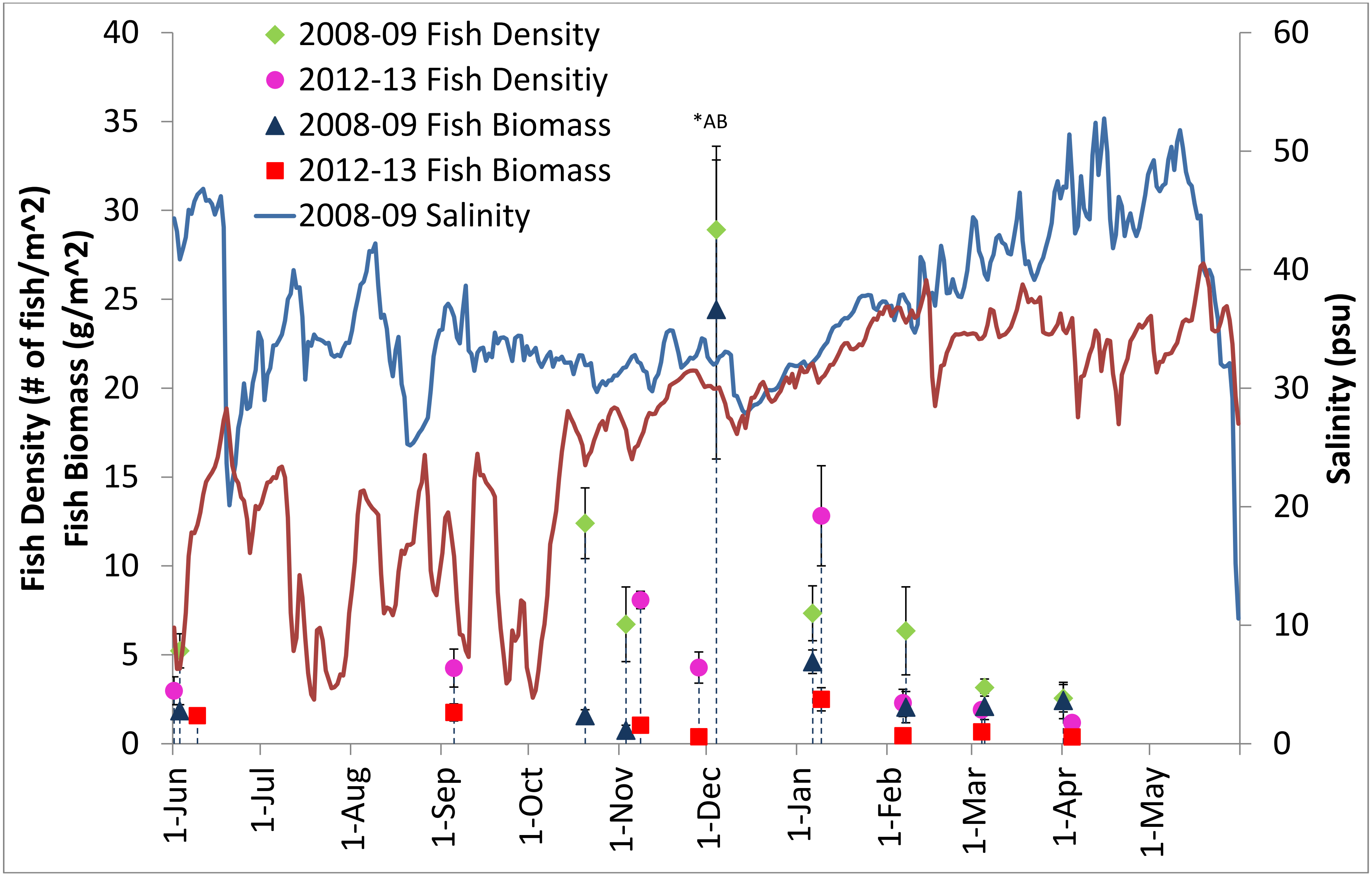


Figure 47. Environmental conditions found at CS, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated stratified mean (±SE) fish density and the estimated stratified mean (±SE) biomass for each fish sample collection (left axis) plotted against the annual salinity level cycle comprised of the daily mean salinity levels for each hydrologic year (right axis). The Density and Biomass scale (right axis) for CS is different from the other prey base fish sample sites in the previous graphs. Asterisk (*) indicates significant ($p>0.01$) differences between years, where A=2008-09 and B=2012-13.

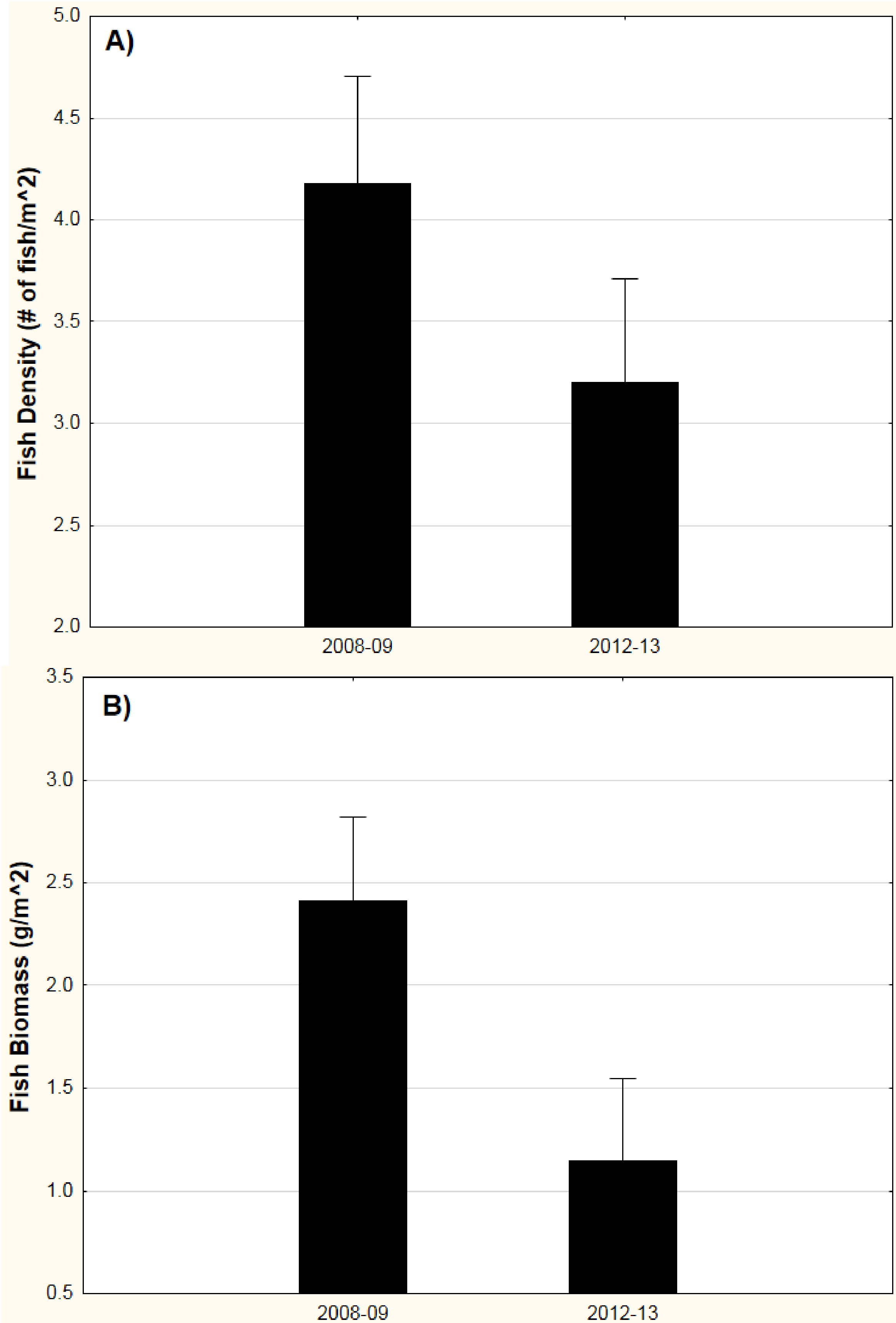


Figure 48. Stratified annual mean for all three watersheds combined for the subject year 2012-13 and the comparison year 2008-09 for the A) fish density per m^2 and B) fish biomass per m^2.

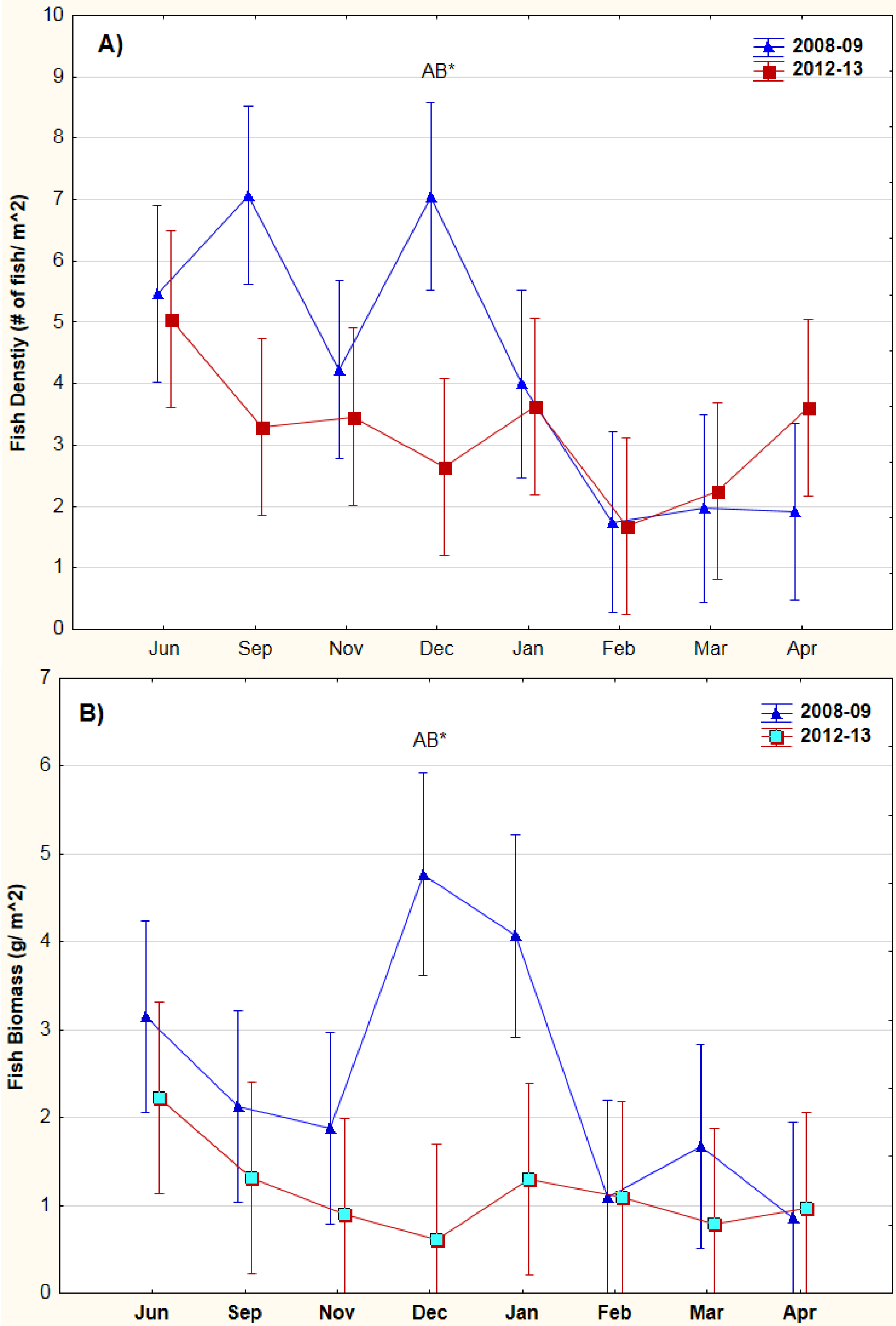


Figure 49. Stratified annual mean for all three watersheds combined for the subject year 2012-13 and the comparison year 2008-09 for the A) fish density per m^2 and B) fish biomass per m^2. Asterisk (*) indicates significant ($p>0.01$) differences between years, where A=2008-09 and B=2012-13.

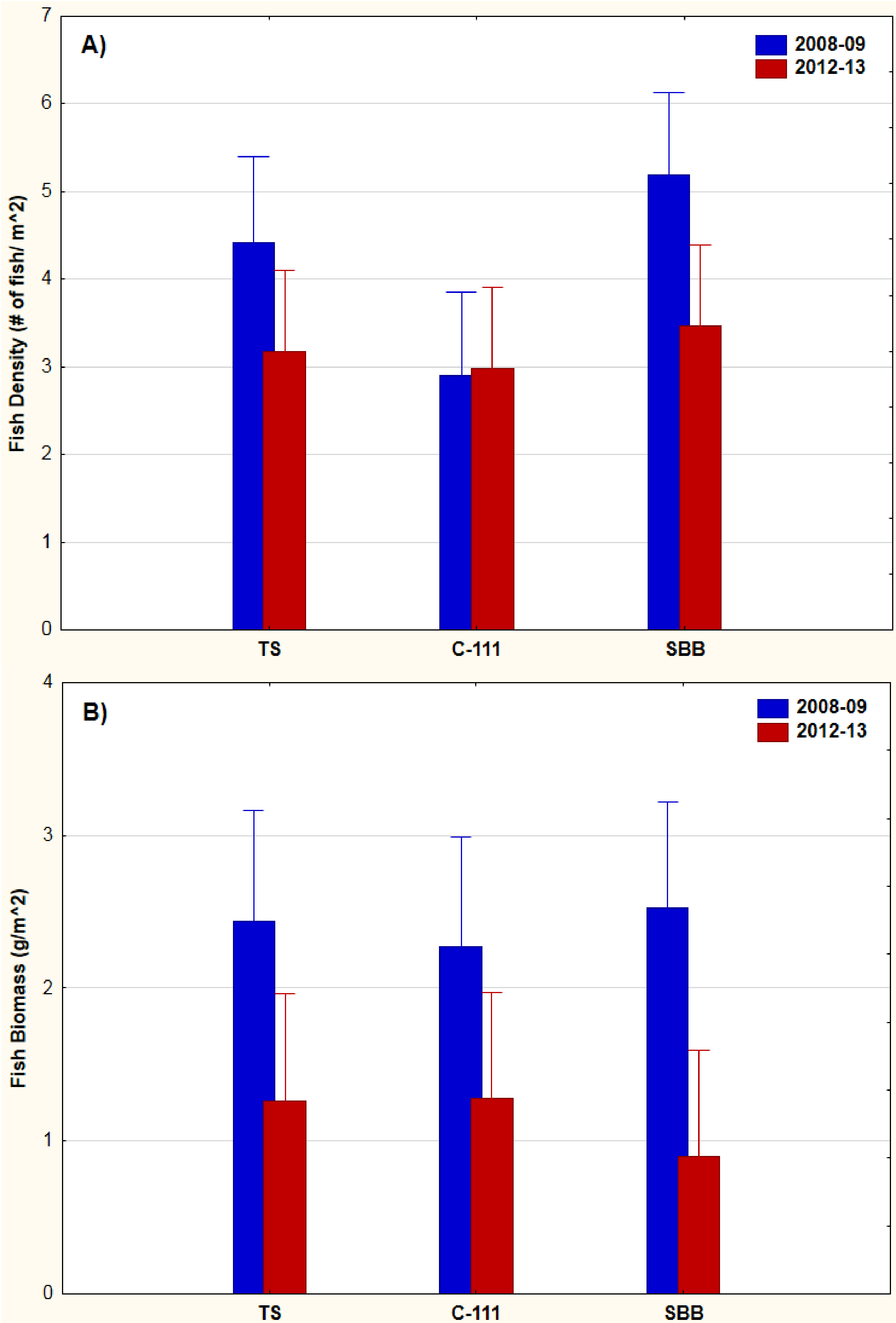


Figure 50. A) Mean stratified fish density per m^2 and B) the mean stratified biomass per m^2 for the report period 2012-13 and the comparison year of 2008-09 within each of the three watersheds. Asterisk (*) indicates significant (p>0.01) differences between years where A=2008-09 and B=2012-13.

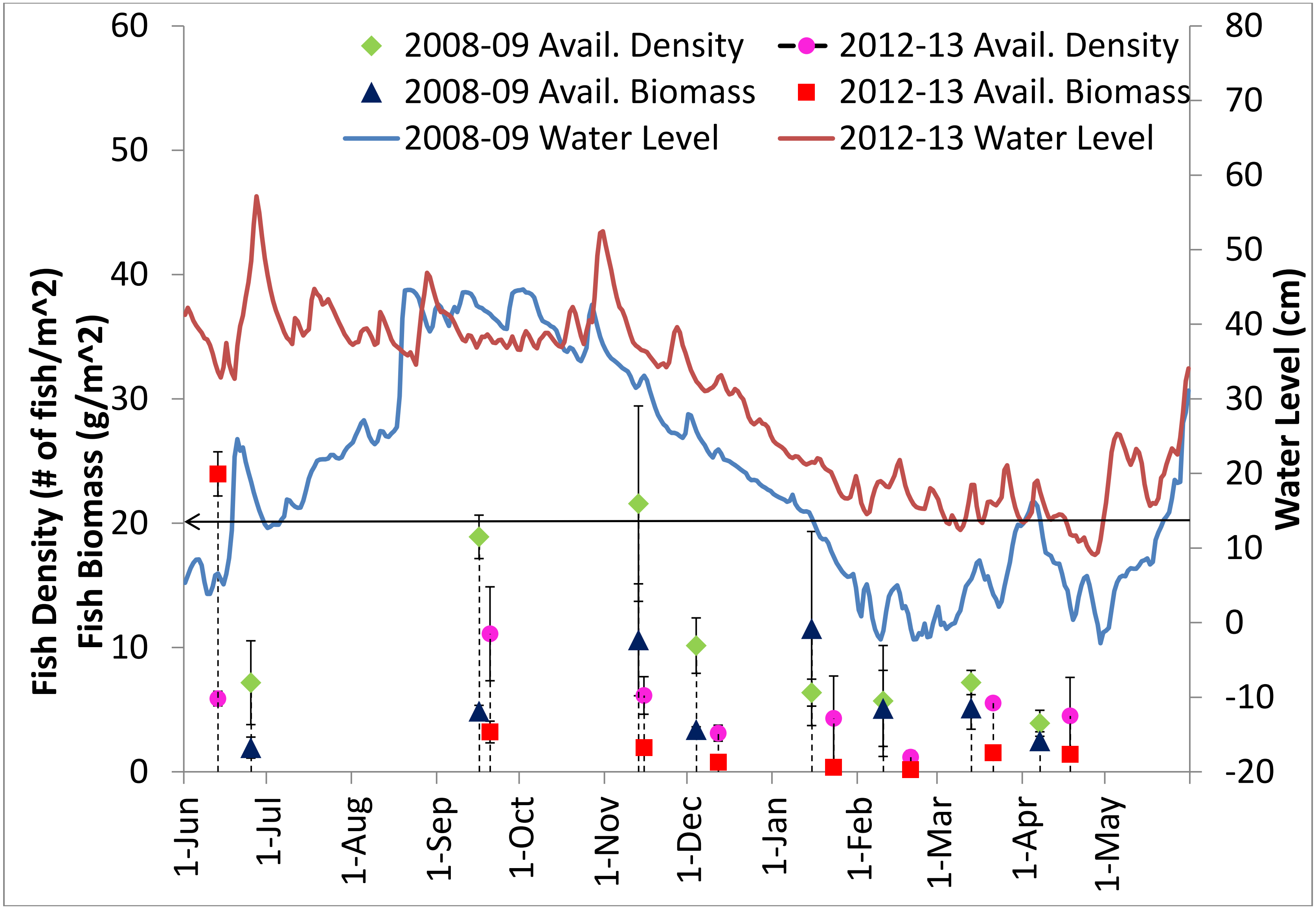


Figure 51. Environmental conditions found at TR, located in the TS Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

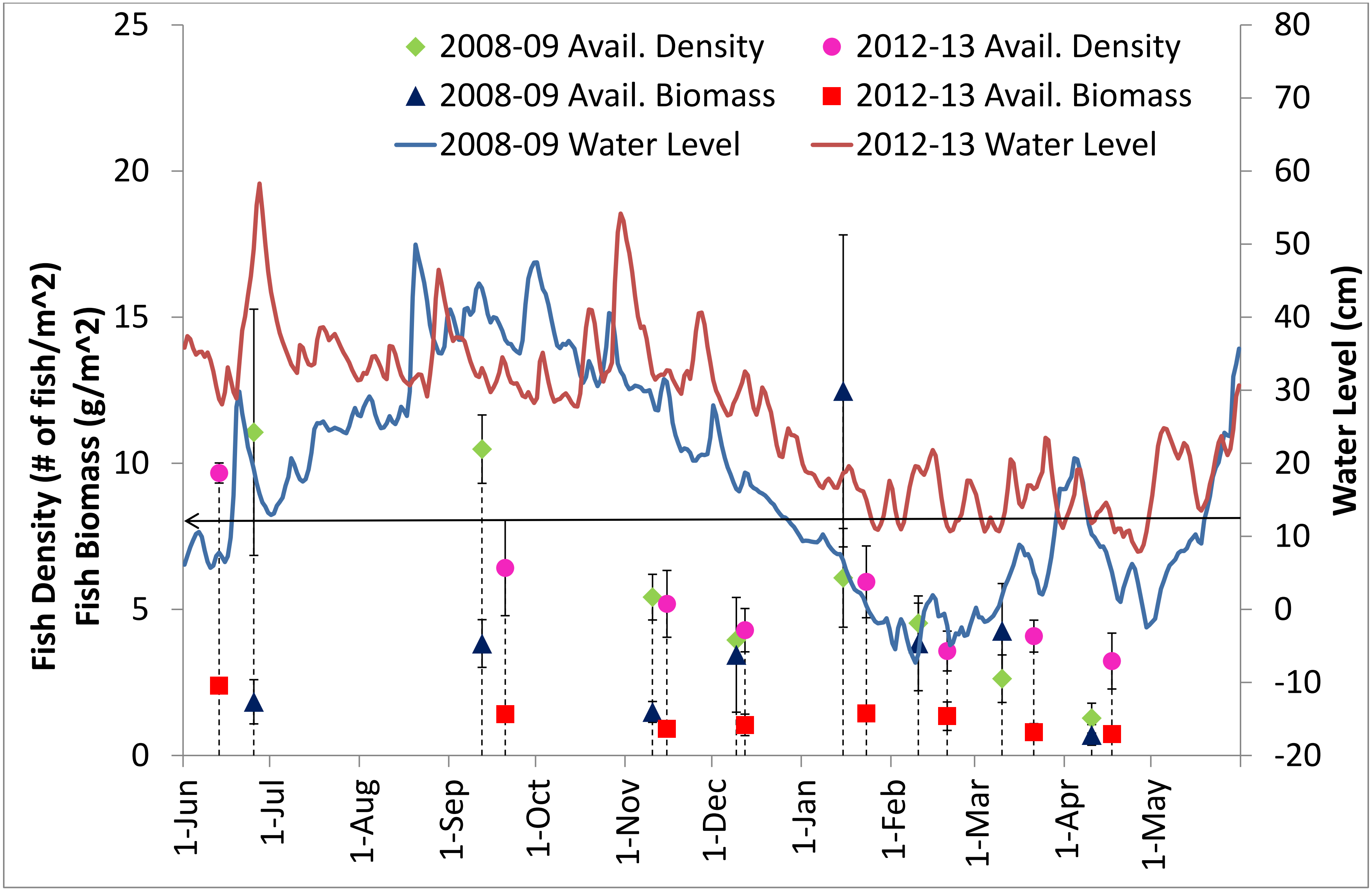


Figure 52. Environmental conditions found at EC, located in the TS Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

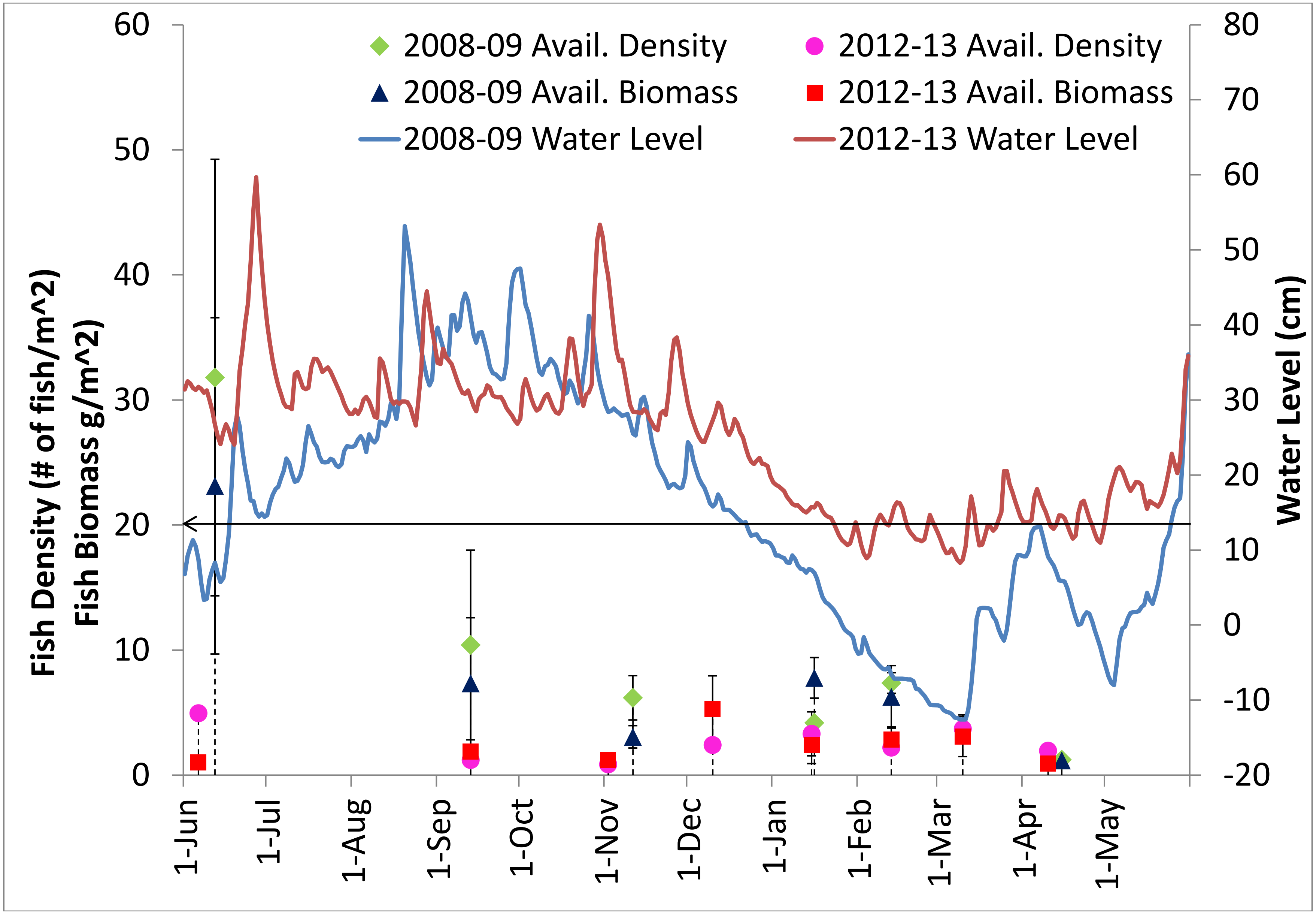


Figure 53. Environmental conditions found at WJ, located in the TS Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

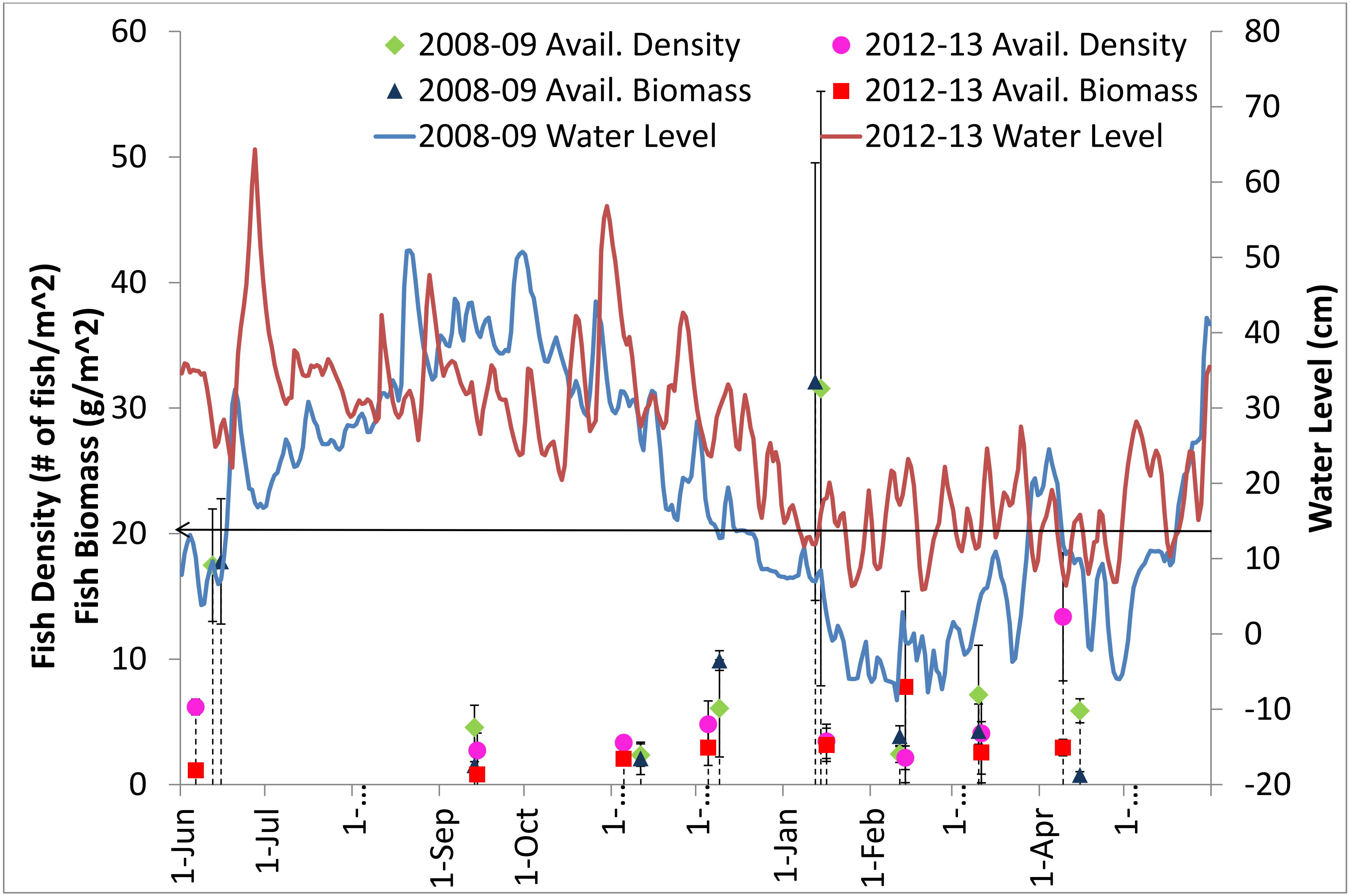


Figure 54. Environmental conditions found at JB, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

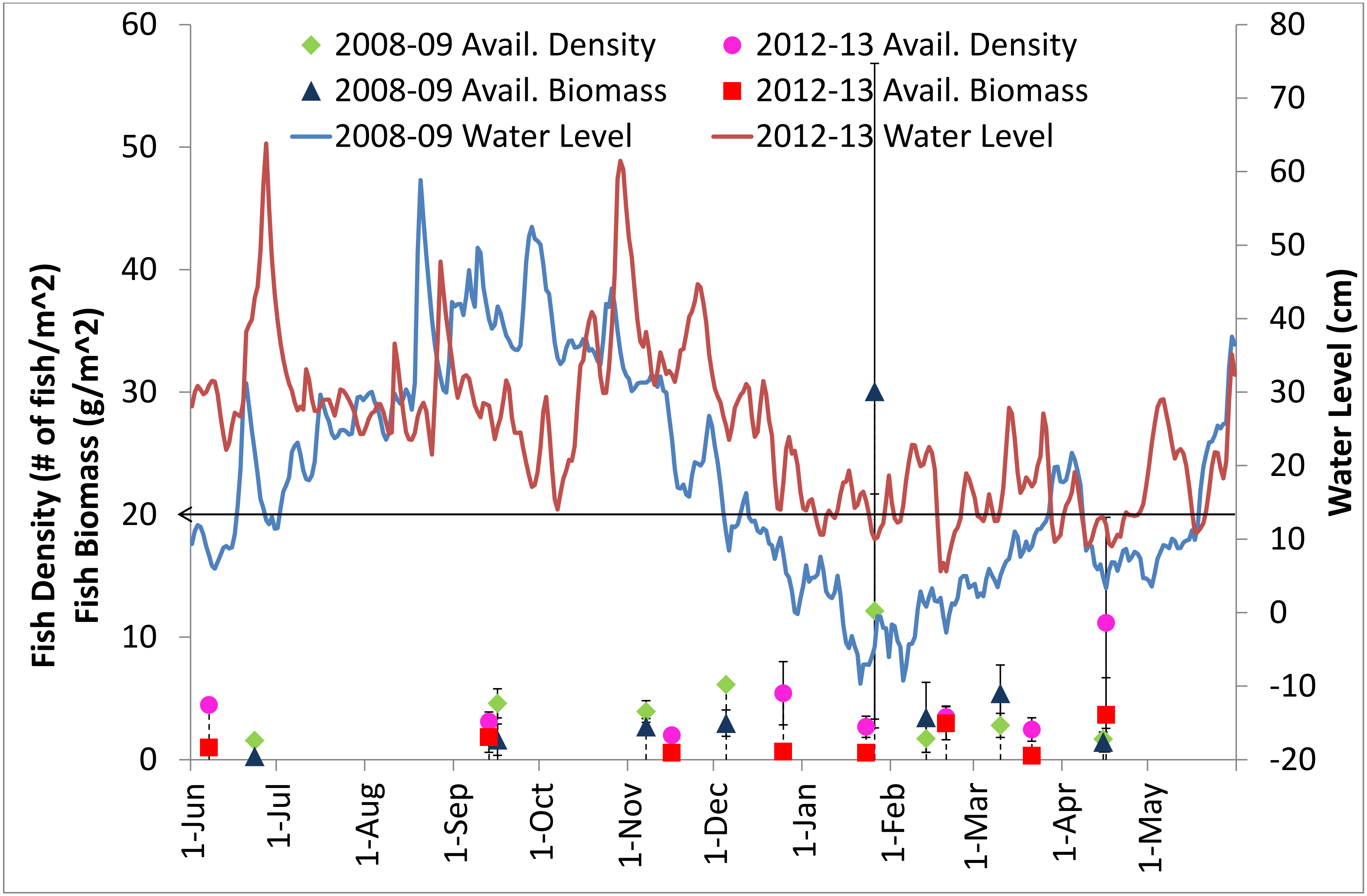


Figure 55. Environmental conditions found at SB, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

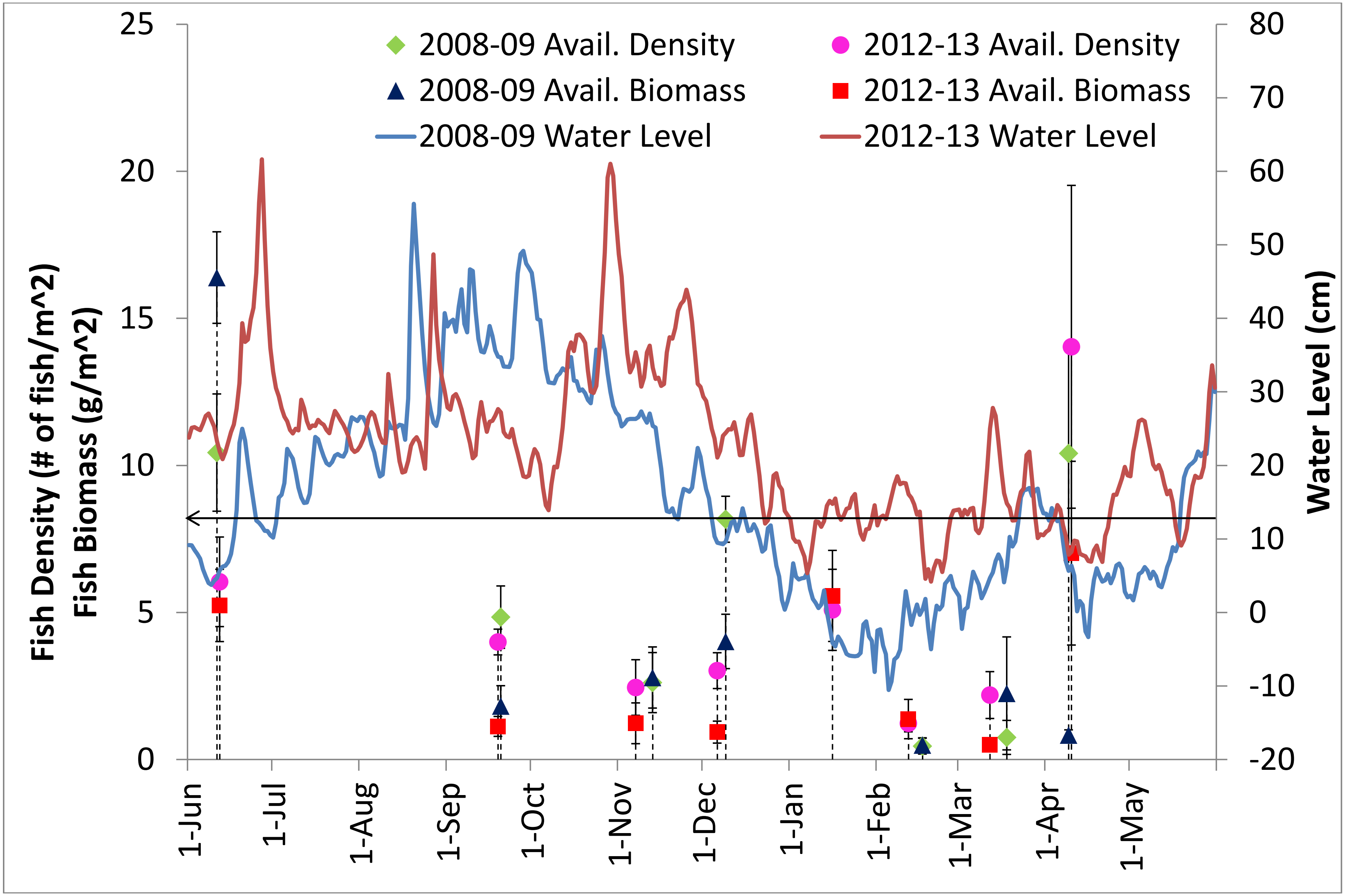


Figure 56. Environmental conditions found at HC, located in the C-111 Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

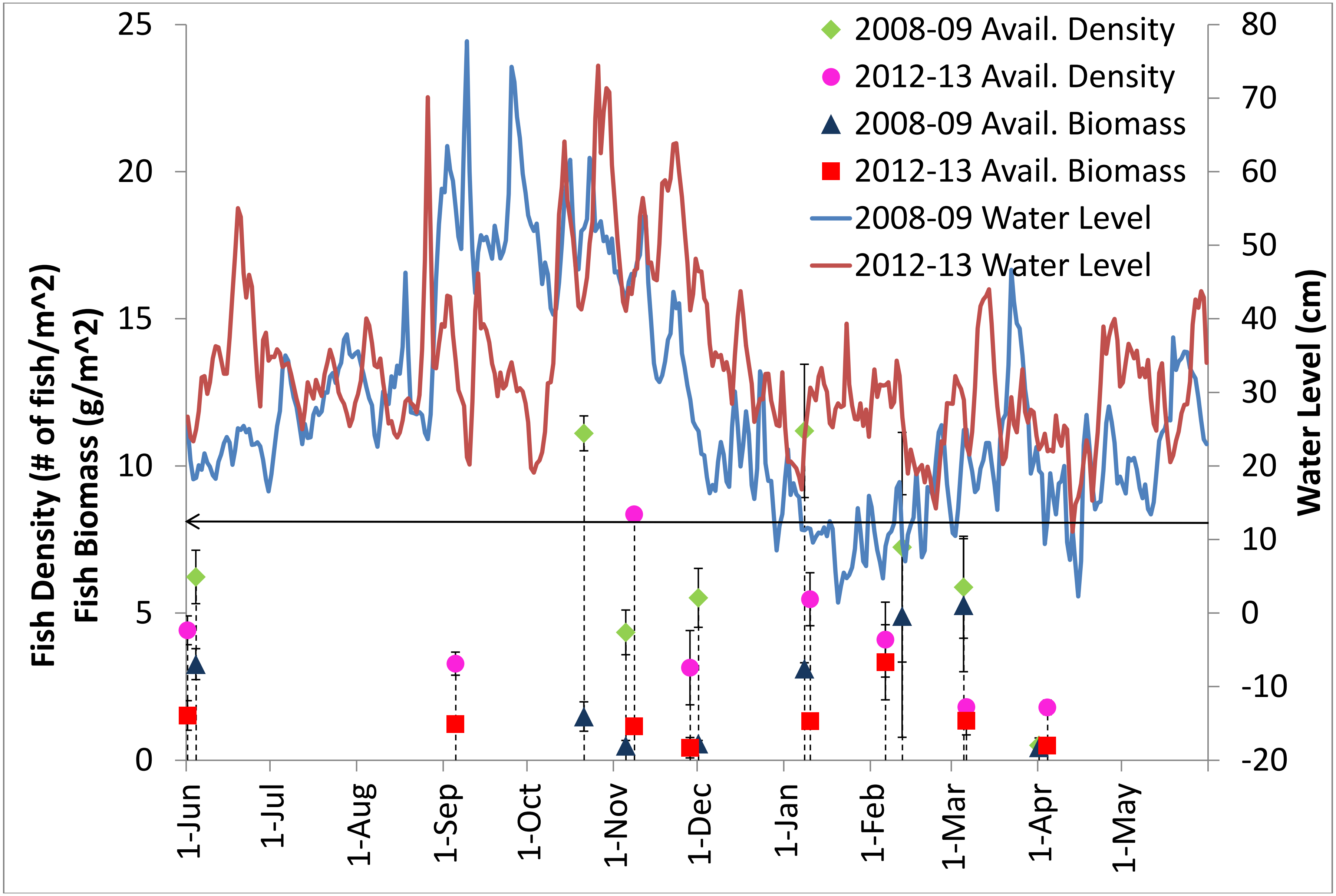


Figure 57. Environmental conditions found at MB, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

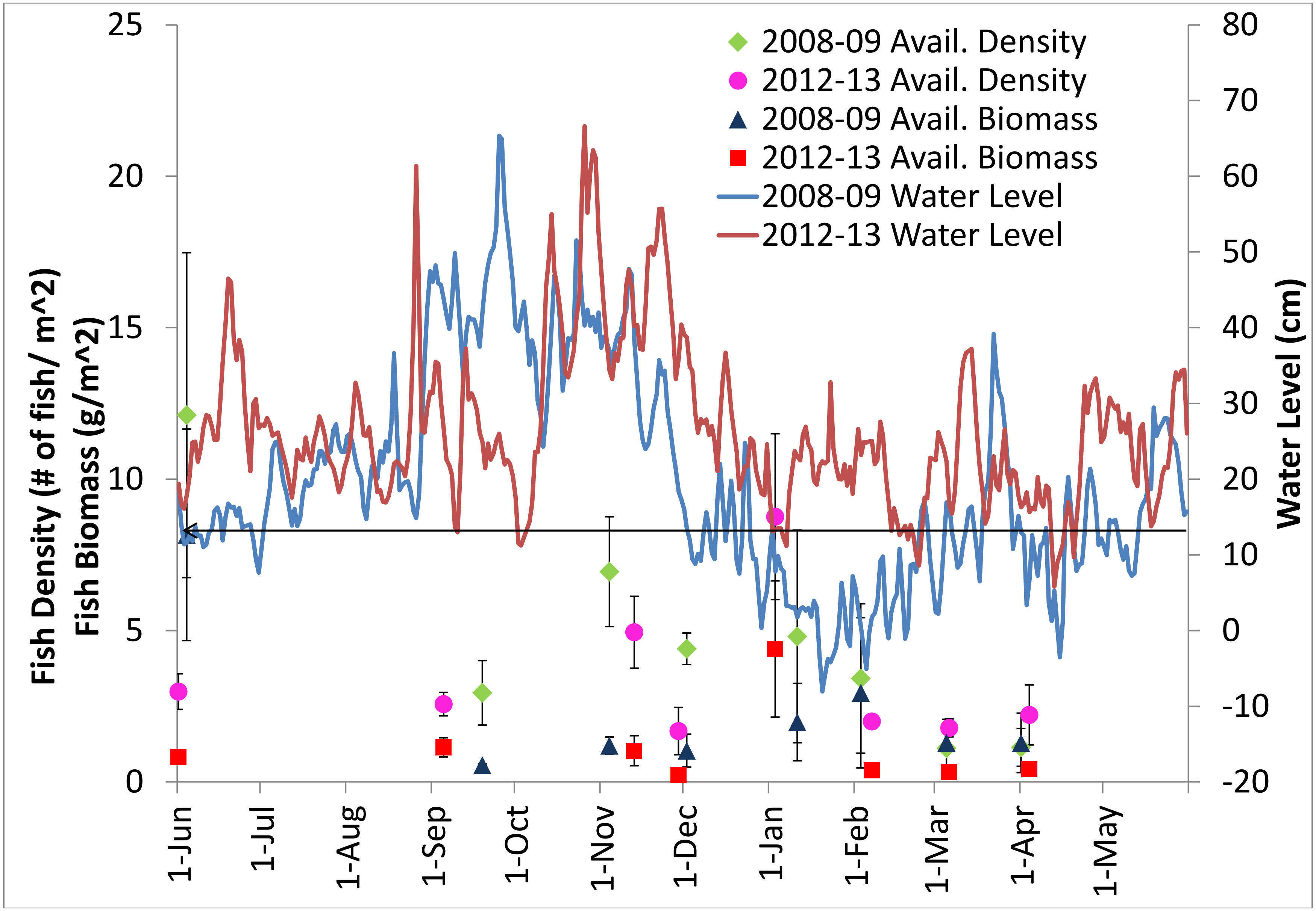


Figure 58. Environmental conditions found at BS, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The horizontal line represents the PCT at a water level of 13cm.

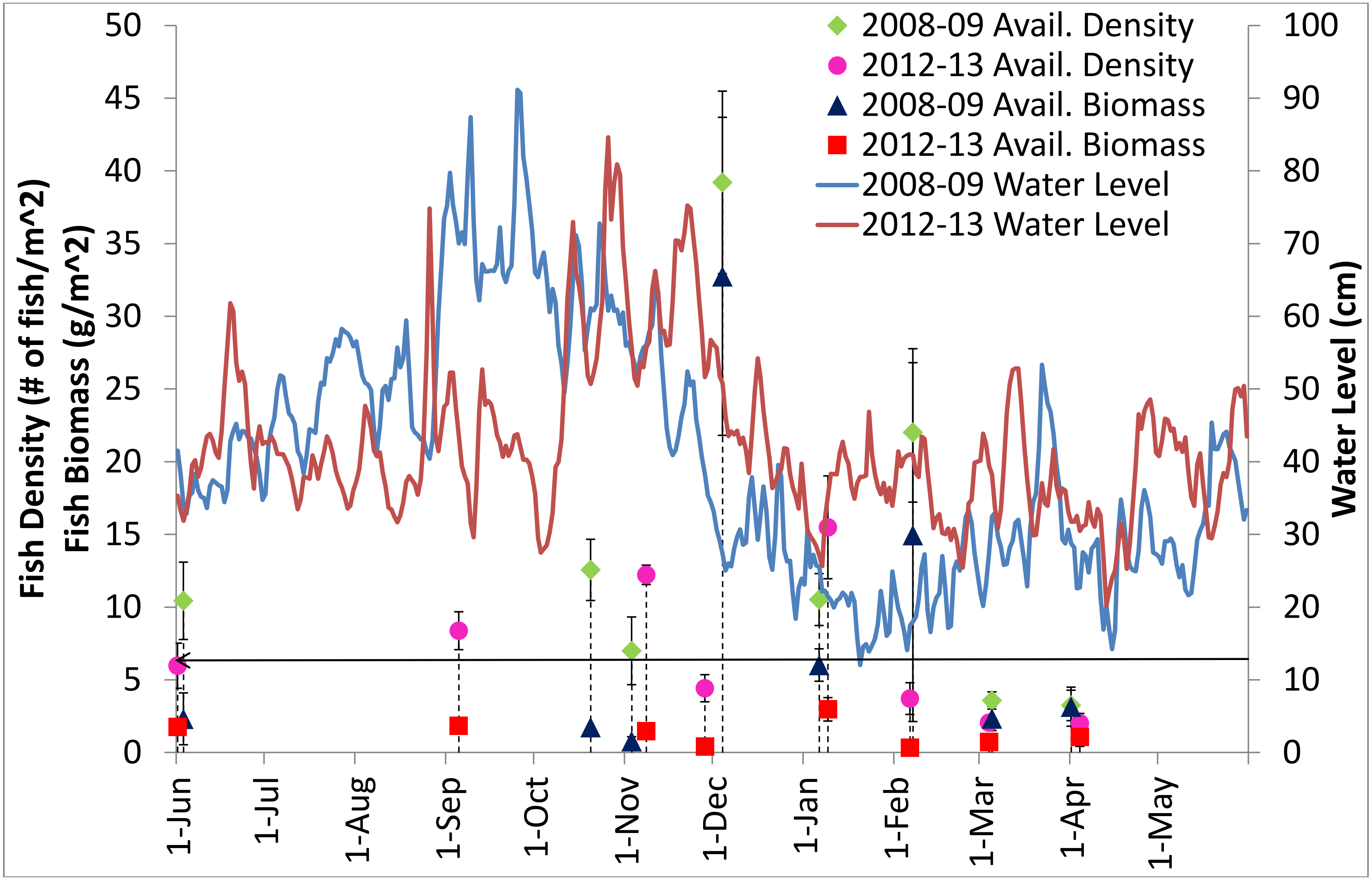


Figure 59. Environmental conditions found at CS, located in the SBB Watershed, during the report period 2012-13 and the comparison year 2008-09. A between year comparison of the estimated mean (±SE) fish available density and the estimated mean (±SE) available biomass for each fish sample collection (left axis) plotted against the annual water level cycle comprised of the daily mean water levels for each hydrologic year (right axis). The Available Density and Biomass scale (right axis) for CS is different from the other prey base fish sample sites in the previous graphs. The horizontal line represents the PCT at a water level of 13cm.

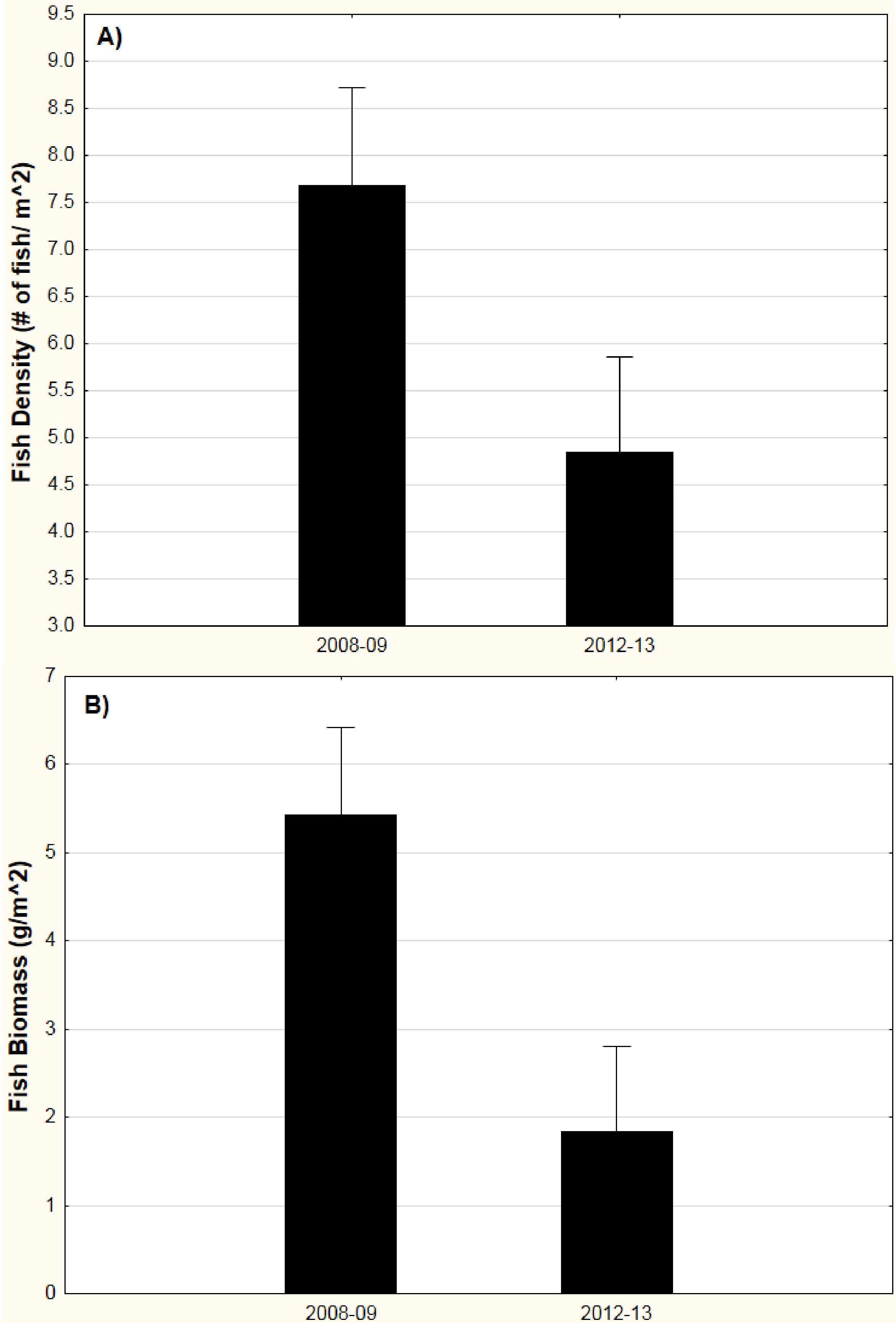


Figure 60. Annual mean for all three watersheds combined for the subject year 2012-13 and the comparison year 2008-09 for the A) fish available density per m^2 and B) fish available biomass per m^2.

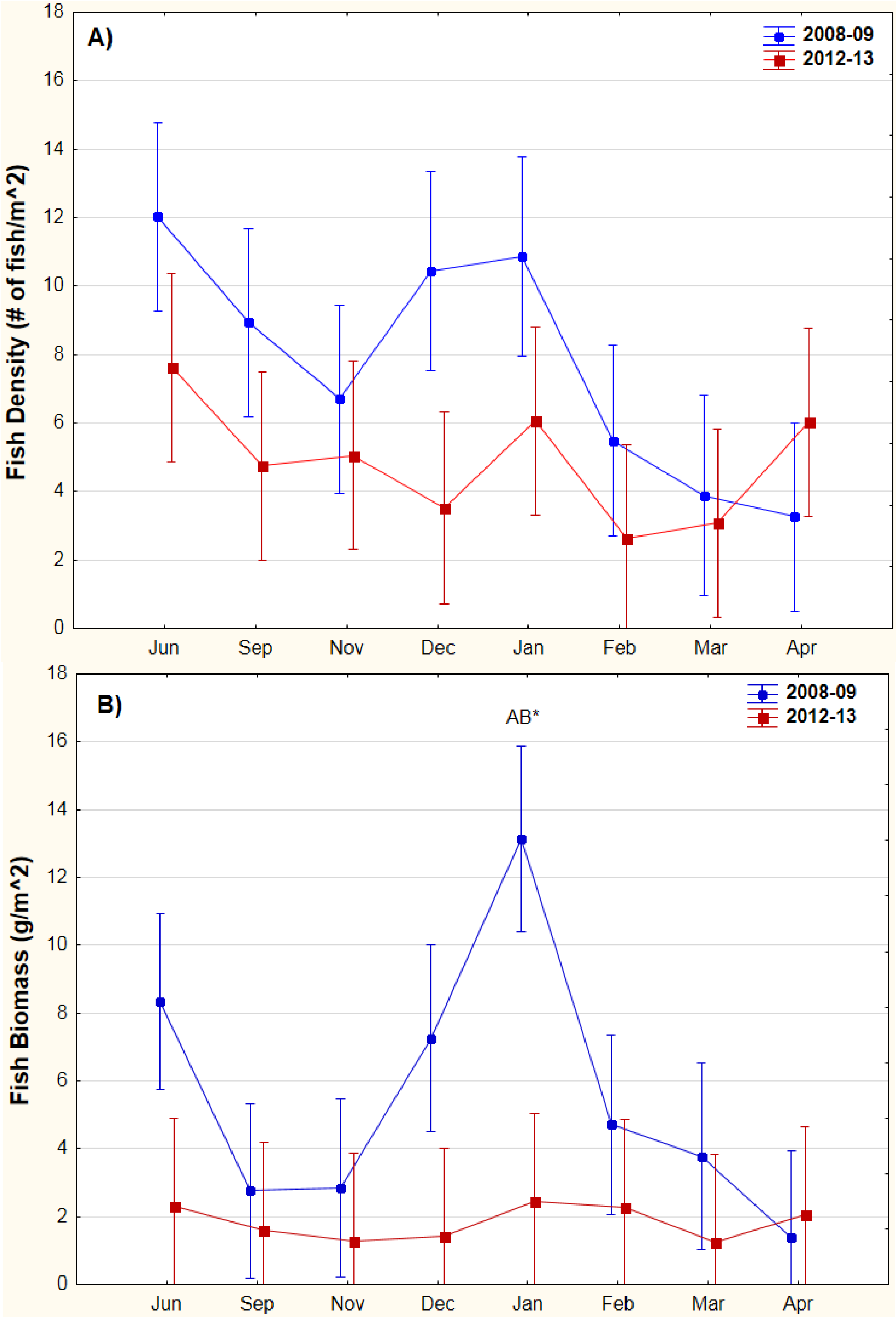


Figure 61. Annual mean for all three watersheds combined for the subject year 2012-13 and the comparison year 2008-09 for the A) fish available density per m^2 and B) fish available biomass per m^2. Asterisk (*) indicates significant ($p>0.01$) differences between years, where A=2008-09 and B=2012-13.

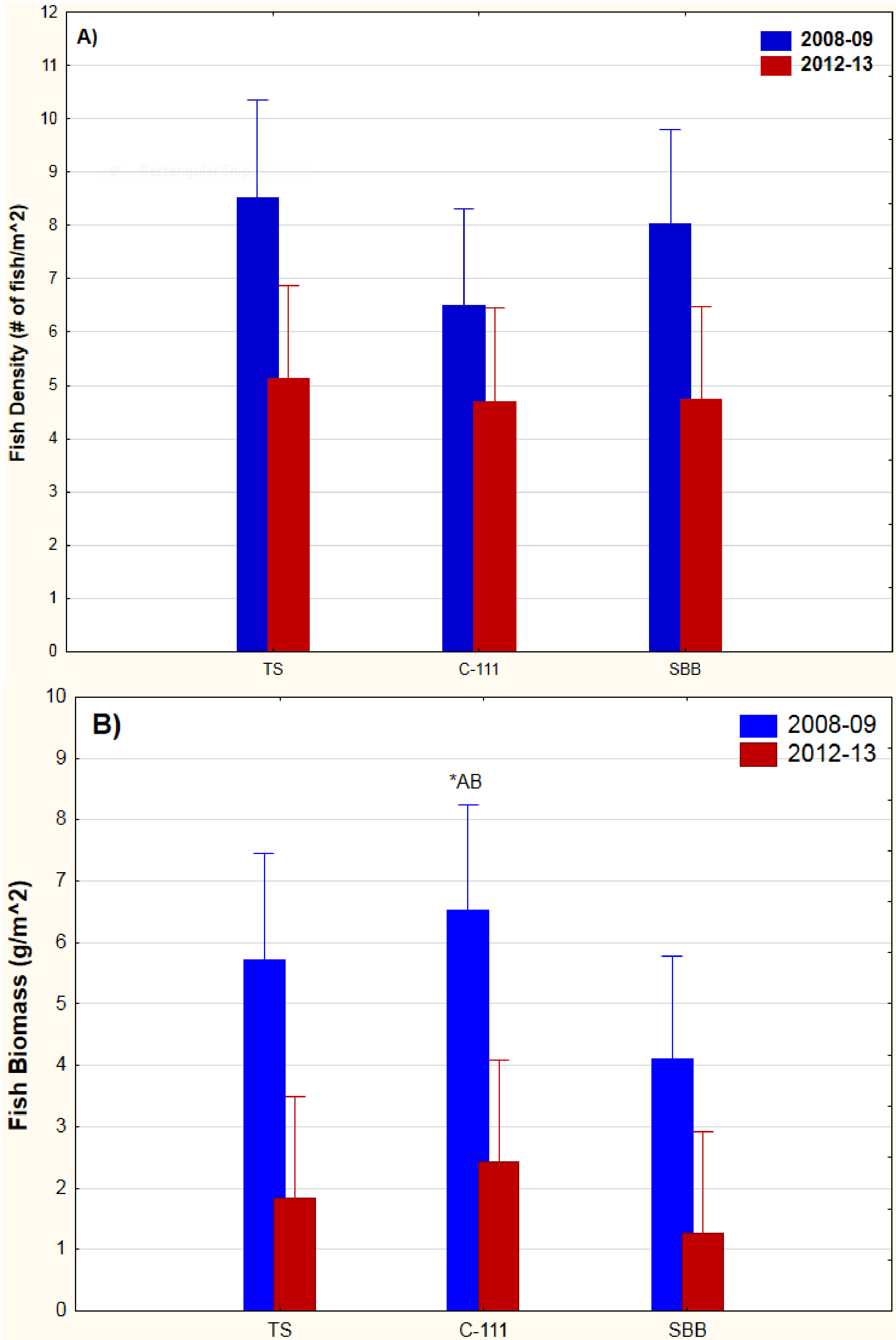
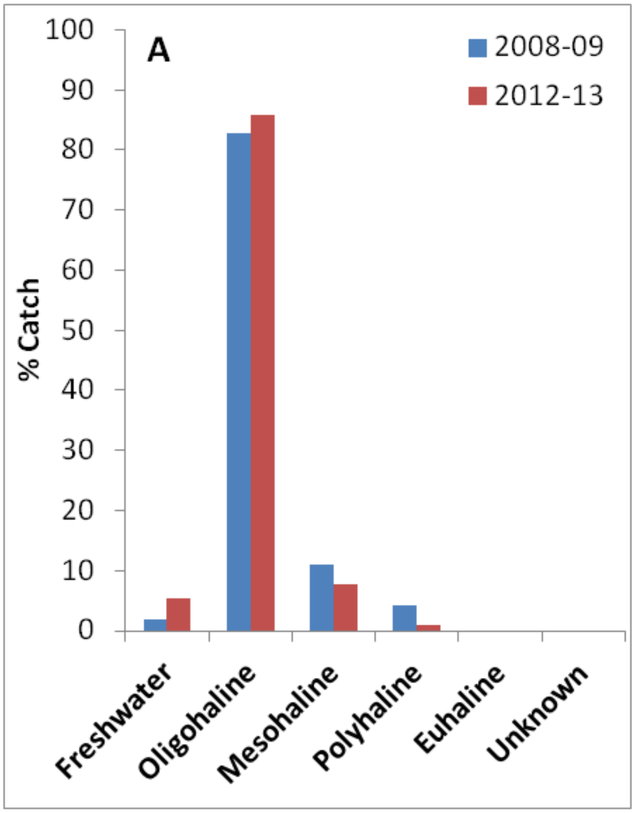
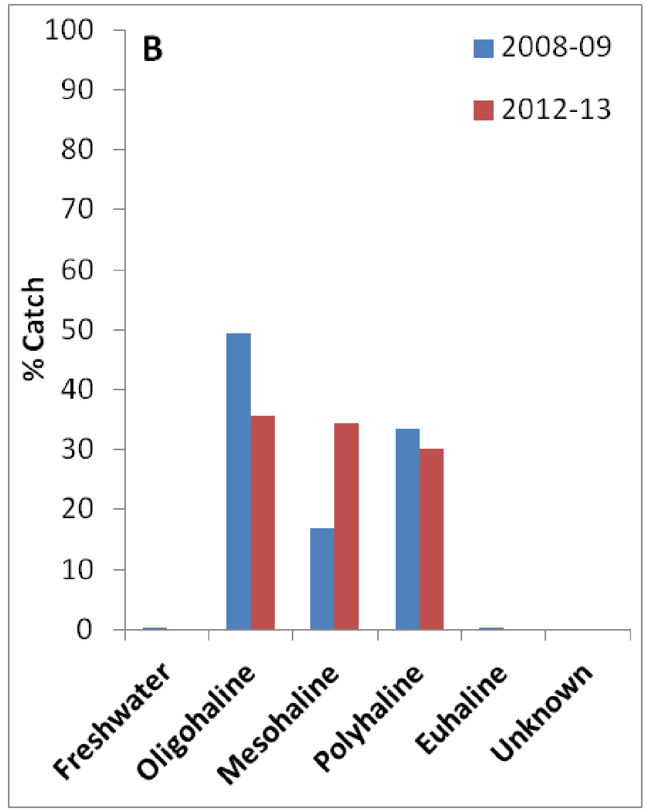


Figure 62. A) Mean fish available density per m^2 and B) available biomass per m^2 for the report period 2012-13 and the comparison year of 2008-09 within each of the three watersheds. Asterisk (*) indicates significant (p>0.01) differences between years where A=2008-09 and B=2012-13.





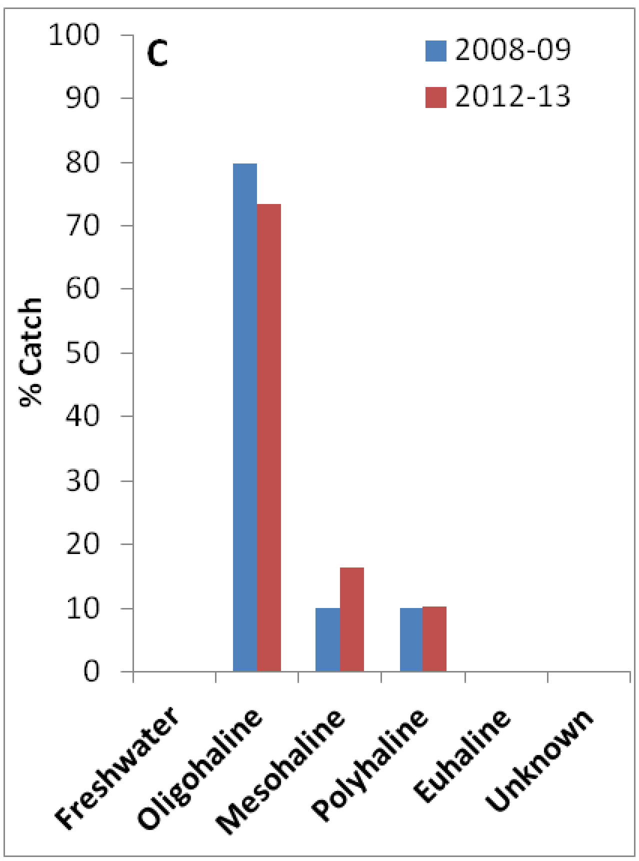


Figure 63. The percentage of the fish community grouped by salinity regime, during 2 hydrologic years at the 3 prey base fish sites in the C-111; (A) JB, (B) SB and (C) HC. Species were grouped by their salinity affinity based on the Venice System of Estuarine Classification.

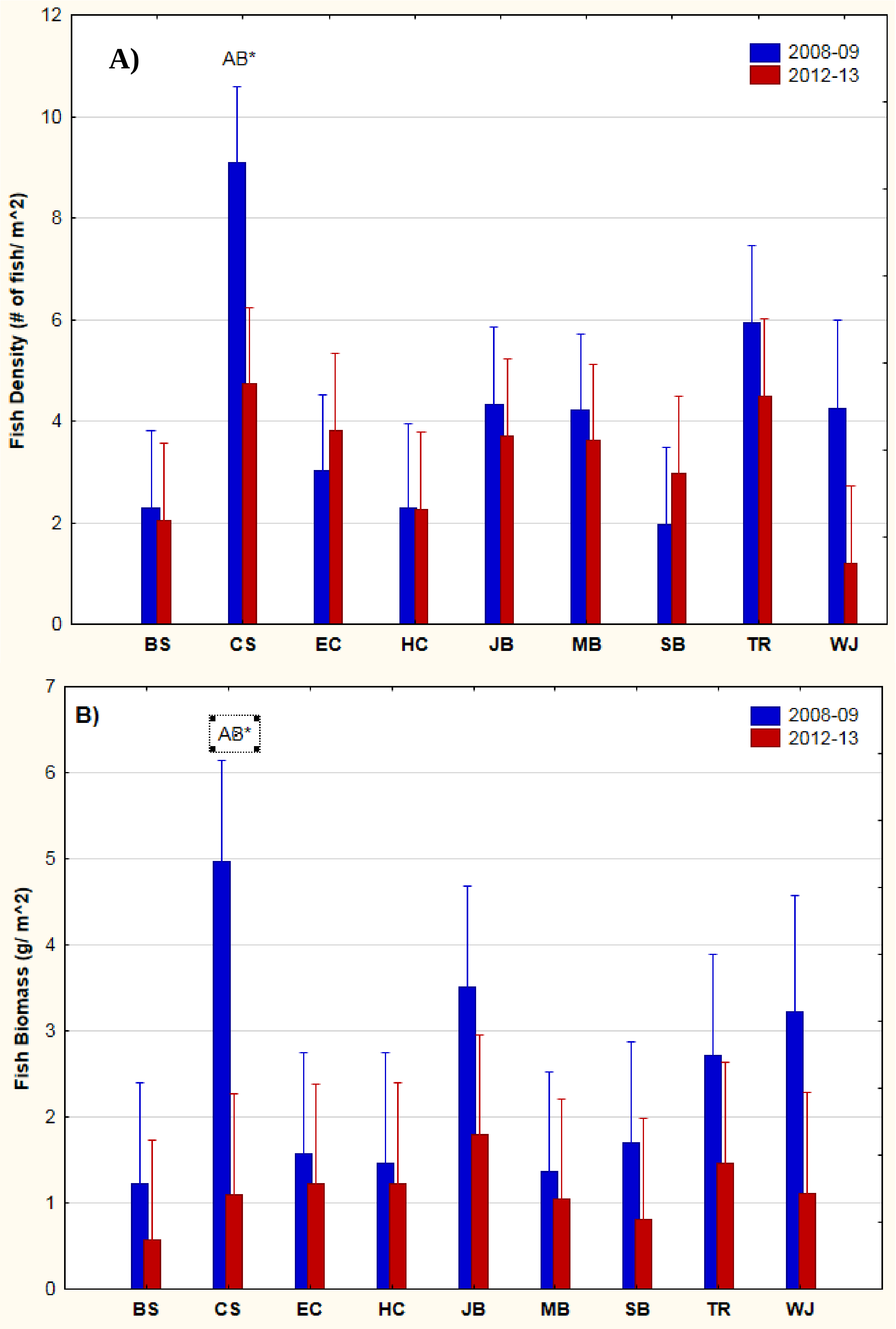


Figure 64. Prey base fish by site for the subject year 2012-13 and the comparison year of 2008-09. A) Mean fish density per m^2. B) Mean fish biomass per m^2. Asterisk (*) indicates significant (p>0.01) differences between years, where A=2008-09, B=2012-13. The available density and biomass is not stratified, but is adjusted according to efficiency results.

Hydrologic Appendix

I. Water Level, Salinity, and Water Temperature graphs for TS Watershed Sites: TR, EC, and WJ. (Figures HA 1- HA3)
II. Water Level, Salinity, and Water Temperature graphs for C-111 Watershed Sites: JB, SB, and HC. (Figures HA 4- HA6)
III. Water Level, Salinity, and Water Temperature graphs for SBB Watershed Sites: BS, MB, and CS. (Figures HA 7- HA9)

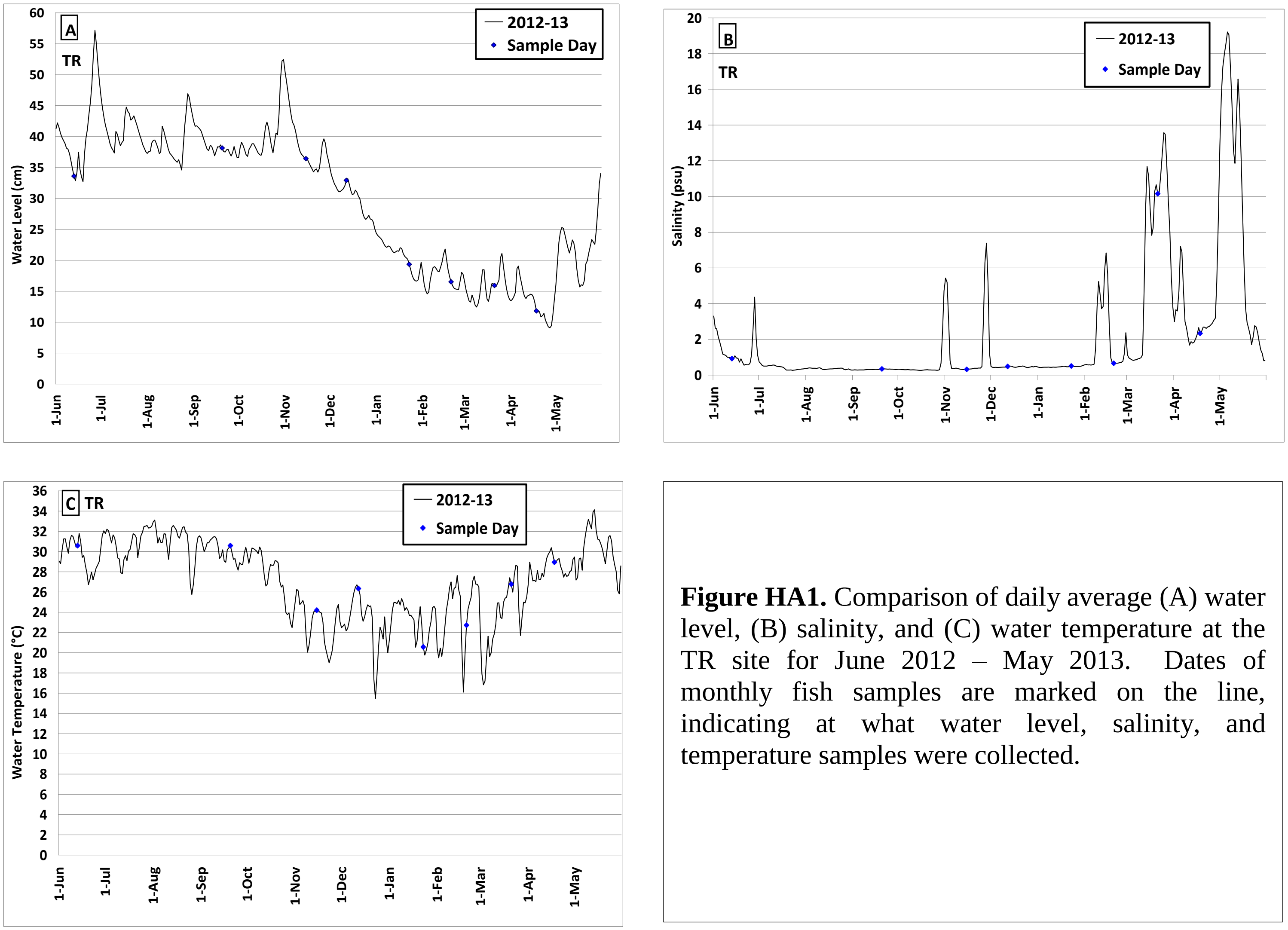
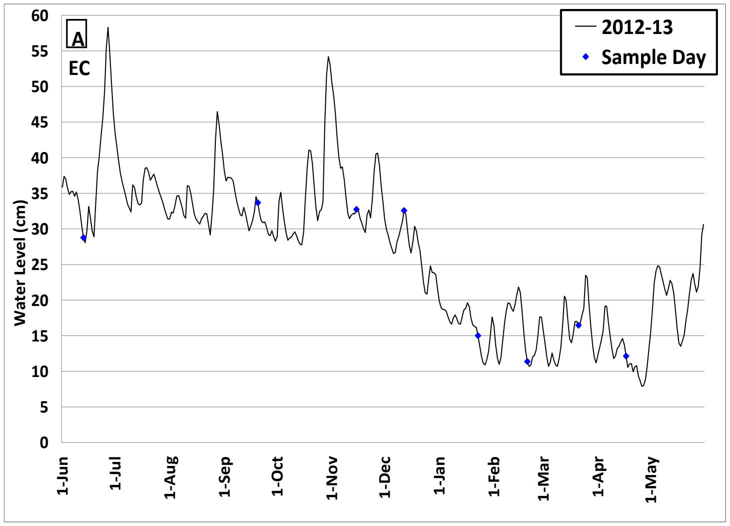
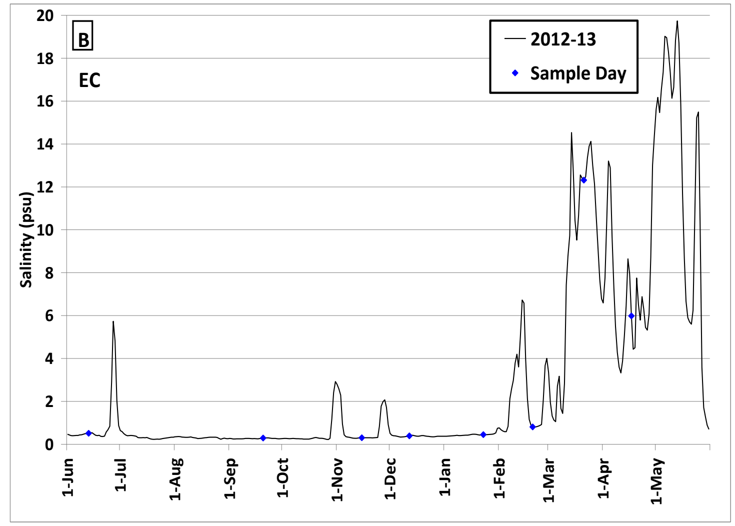


Figure HA1. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the TR site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





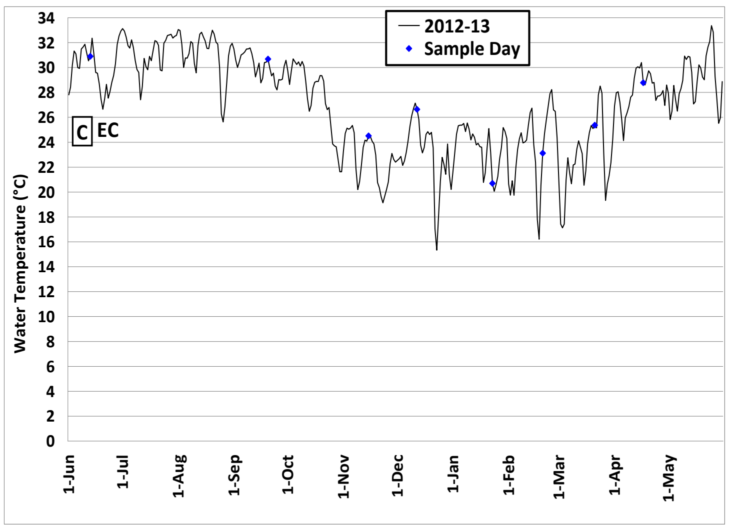
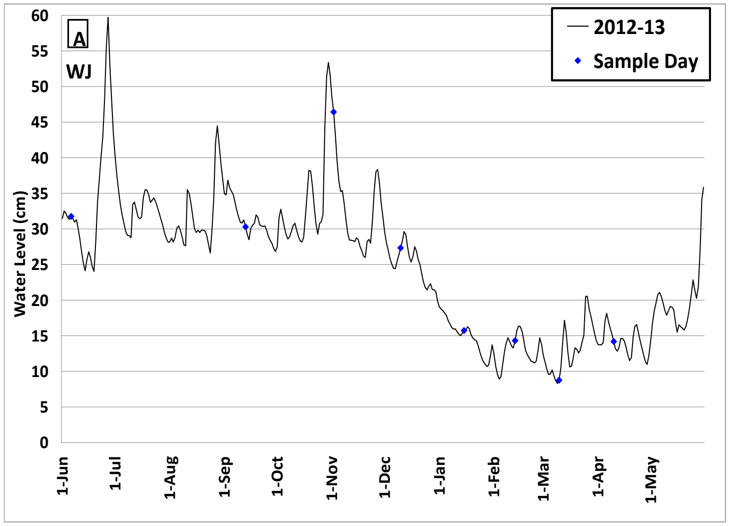
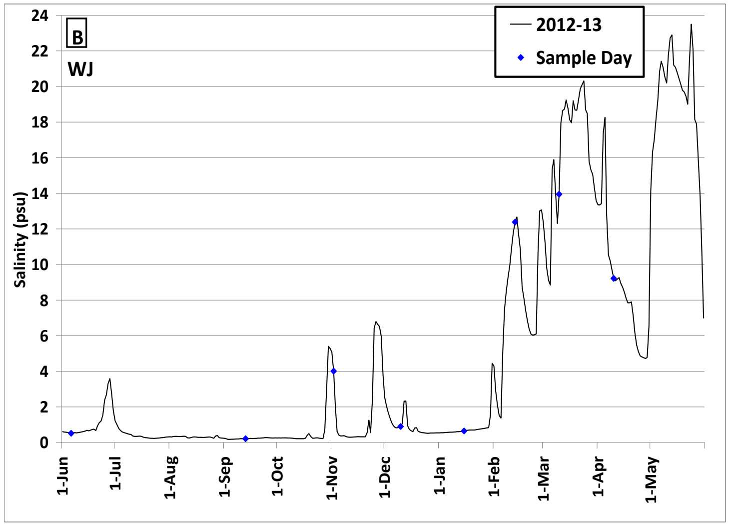


Figure HA2. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the EC site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





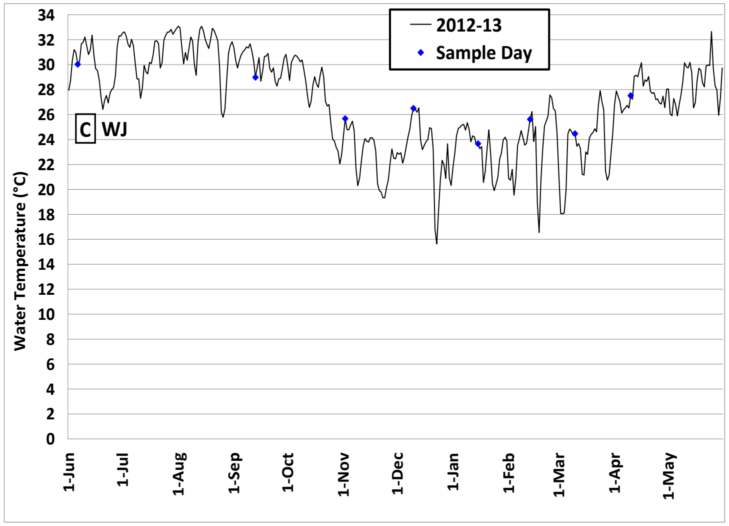
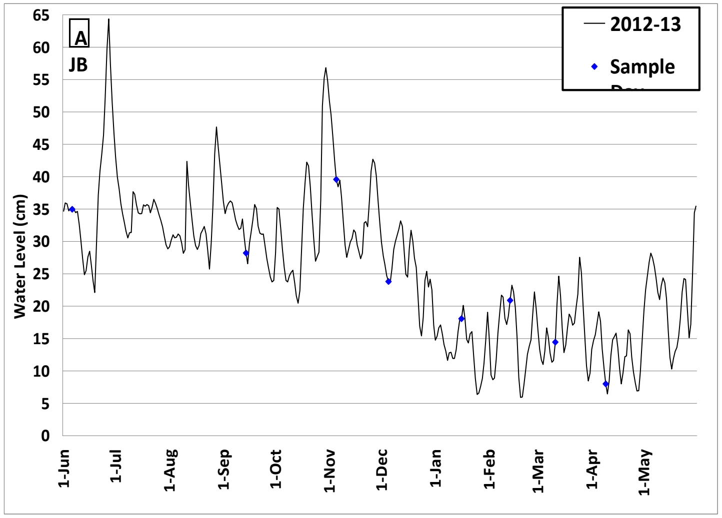
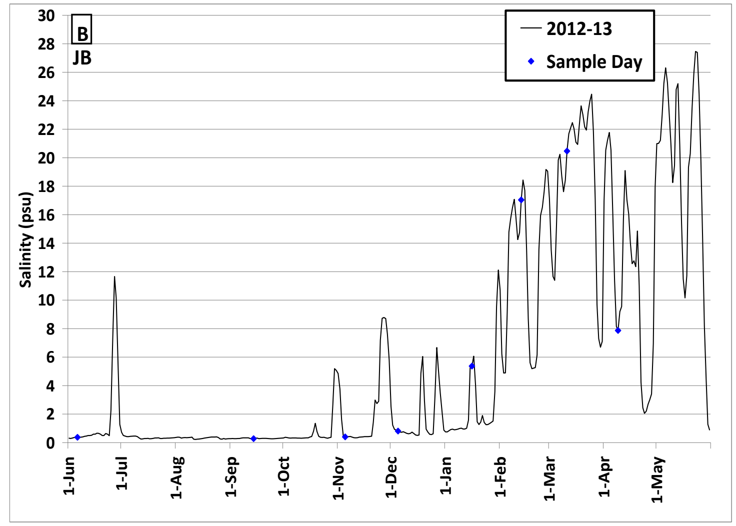


Figure HA3. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the WJ site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





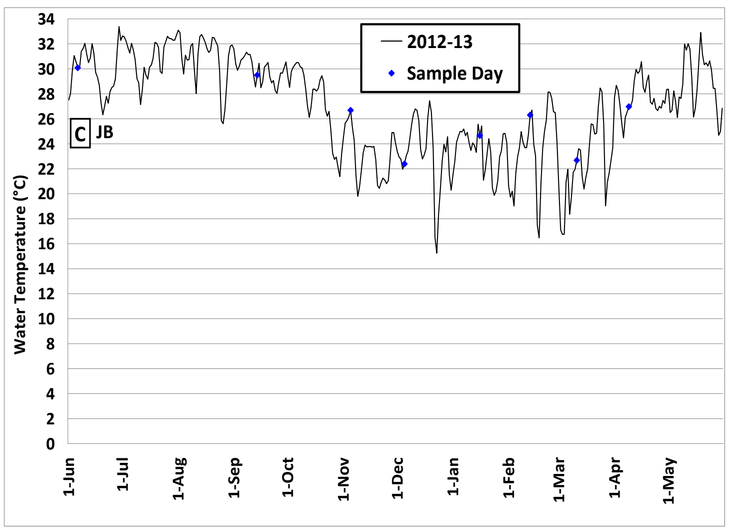
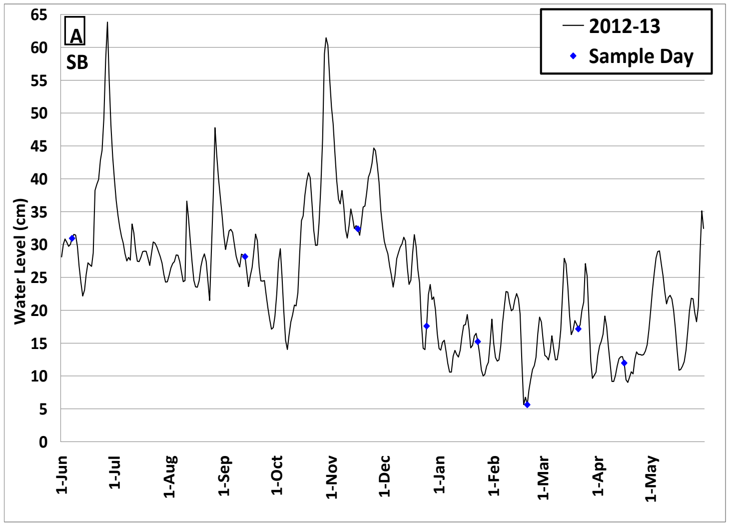
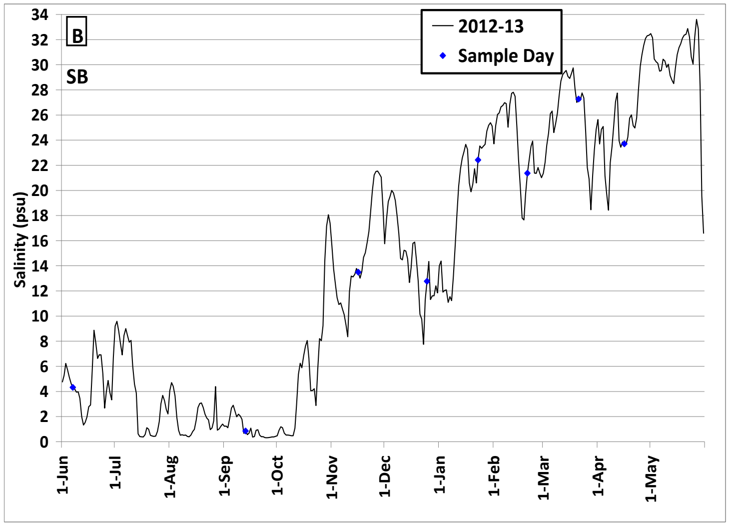


Figure HA4. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the JB site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





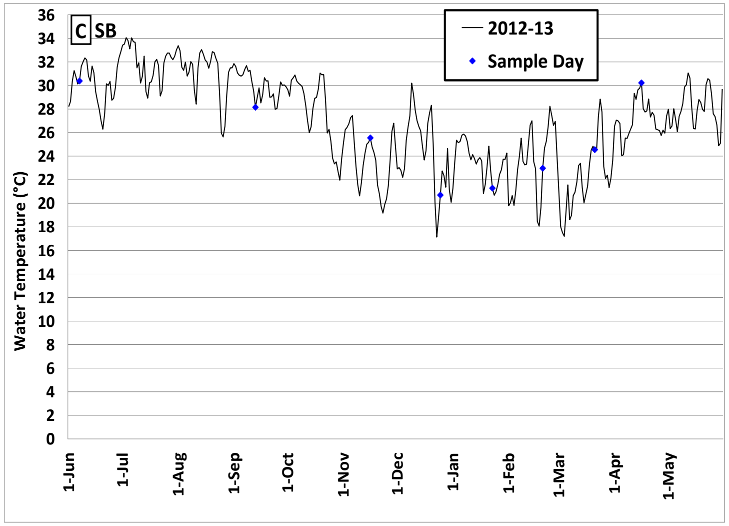
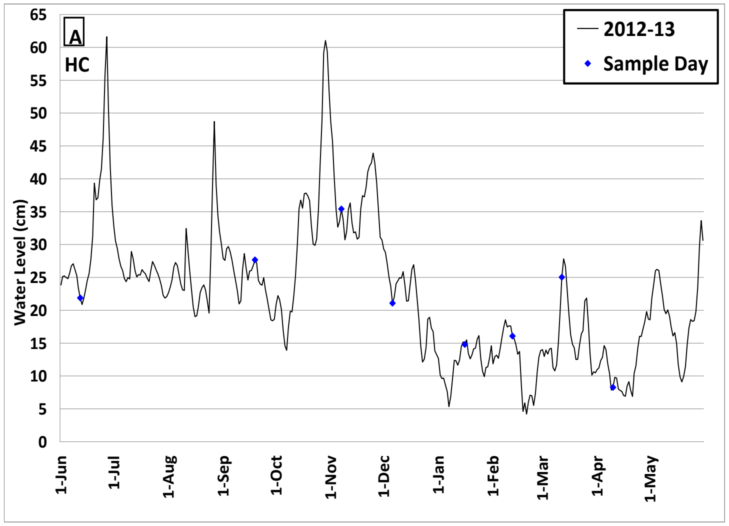
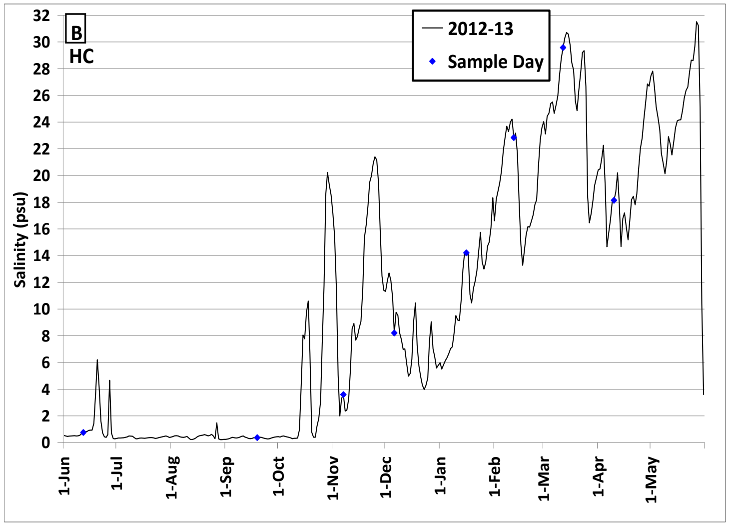


Figure HA5. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the SB site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





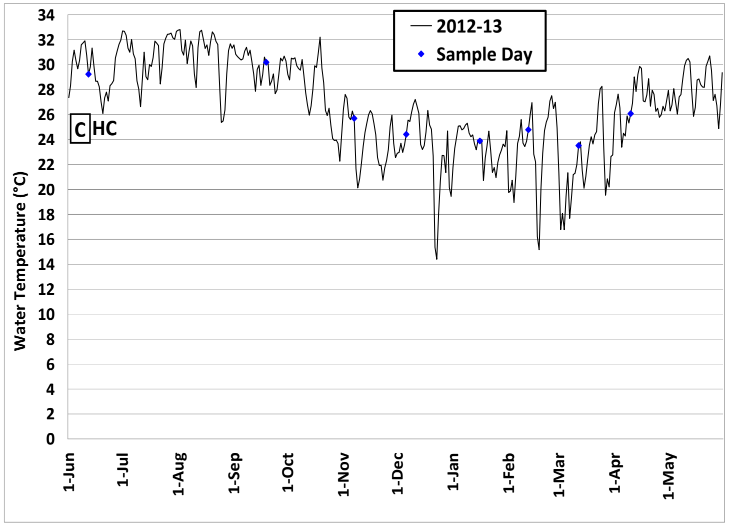
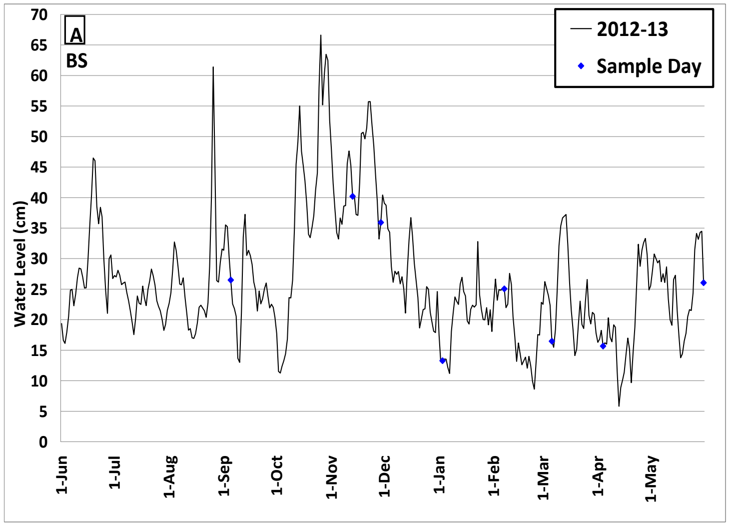
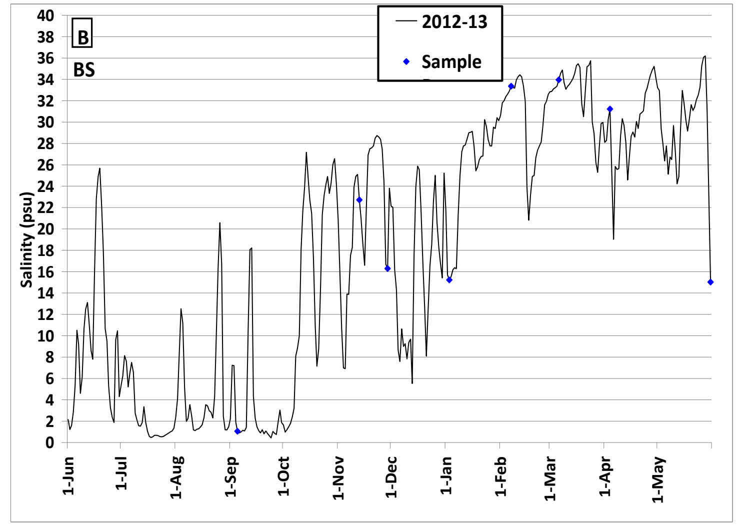


Figure HA6. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the HC site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





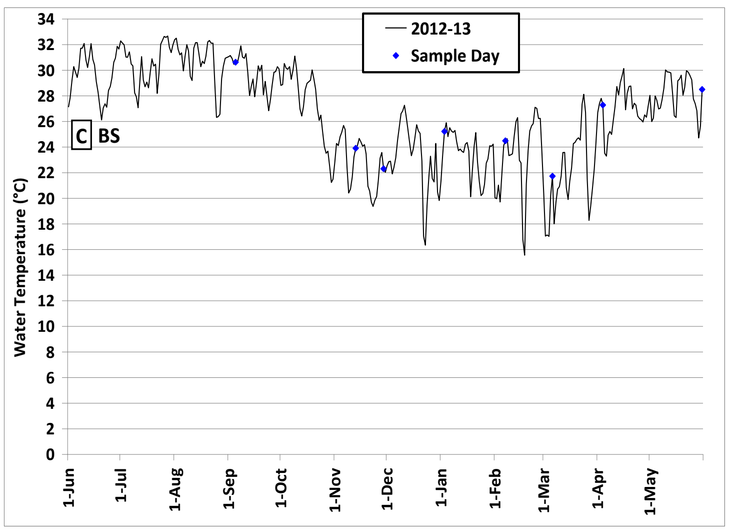
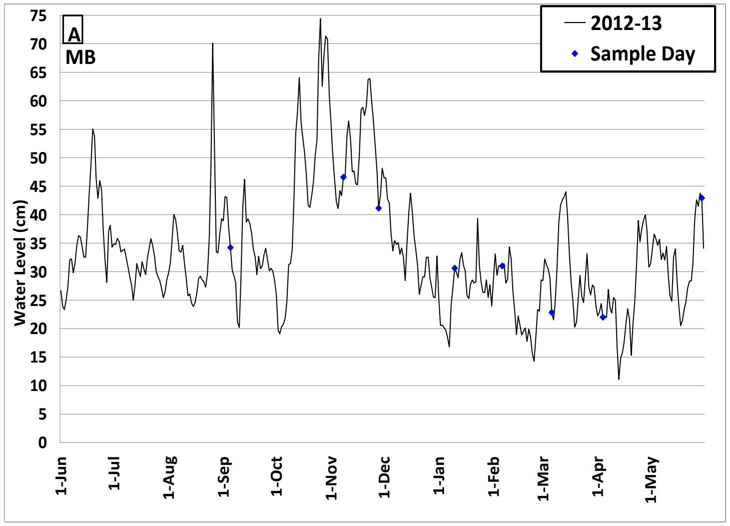
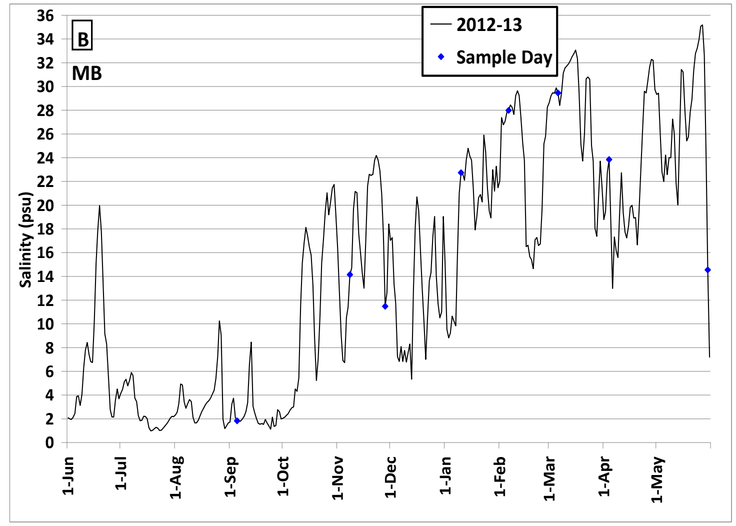


Figure HA7. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the BS site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





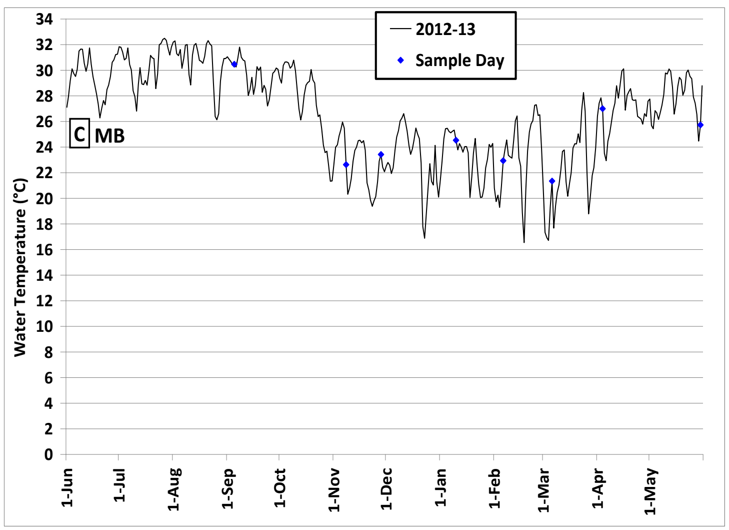
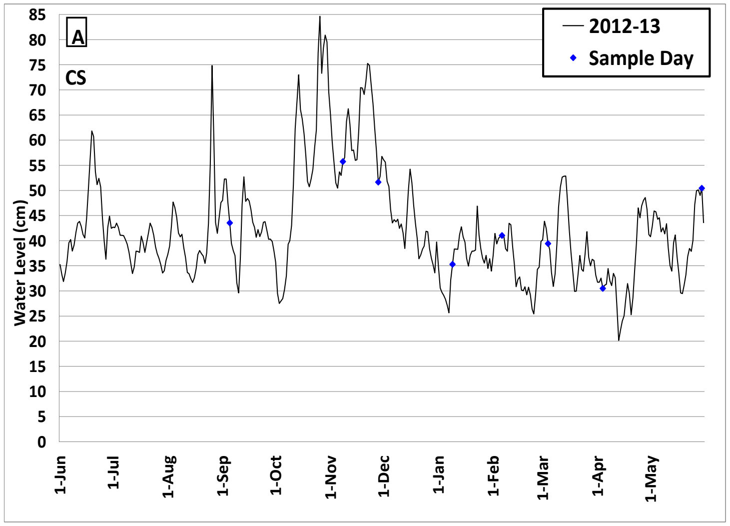
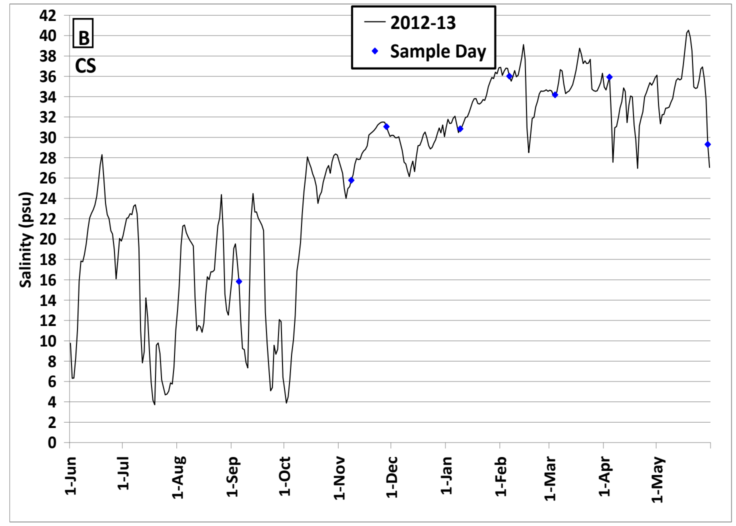


Figure HA8. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the MB site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.





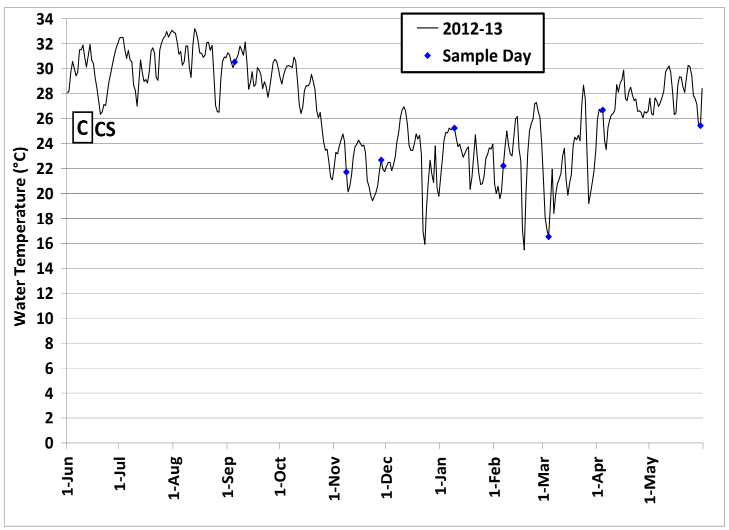


Figure HA9. Comparison of daily average (A) water level, (B) salinity, and (C) water temperature at the CS site for June 2012 – May 2013. Dates of monthly fish samples are marked on the line, indicating at what water level, salinity, and temperature samples were collected.

SAV Appendix

I. Summary of SAV surveys for TS (TR,EC,WJ), C-111 (JB,SB,HC), and SBB (BS,MB,CS) Watersheds by site (Tables SA1- SA9)
II. Total SAV % Cover for TS (TR,EC,WJ), C-111 (JB,SB,HC), and SBB (BS,MB,CS) Watersheds by site (Figures SA1 – SA8)

I. For the following SAV Tables, physical data were measured on site prior to commencing surveys. 'Salinity' and 'Water Temperature' were measured using a YSI EC300. 'Water Depth' is the average water depth for quadrats surveyed and was measured using a pipe marked in 1 cm increments. 'Secchi Depth' is a measure of water clarity based on the 8" secchi disk reading. 'Bottom' indicates Secchi depth exceeding water depth. 'Sediment Depth' is the average of 3 measurements of sediment down to bedrock and was measured using a pipe marked in 1 cm increments.

Table SA1. Summary of SAV surveys conducted at Taylor River (TR 1-6) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Utricularia sp., Chara hornemanii, Najas marina, Ruppia maritima, Batophora oerstedii, Cladophora sp., Nitella sp., Acetabularia sp., Halodule wrightii, Thalassia testudinum, Sargassum sp.*, and *Polysiphonia sp.*

TR1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*	*Nit sp.*
19-Jul-12	0.3	102.0	bottom	30.5	36.3	53.00	0.00	19.83	2.00	7.83	34.67	3.17	0.83
19-Sep-12	0.4	103.0	bottom	31.6	24.0	58.00	1.00	22.00	6.00	3.67	35.50	0.00	0.83
14-Nov-12	0.4	91.0	bottom	25.0	30.0	64.33	0.00	16.33	0.83	4.33	56.17	0.00	1.67
24-Jan-13	0.5	82.0	bottom	20.7	21.7	59.83	0.33	14.00	0.33	1.67	46.50	0.00	0.83
20-Mar-13	14.7	78.0	bottom	26.8	54.7	28.50	0.33	4.50	0.17	1.00	25.50	0.00	0.17
15-May-13	11.9	89.0	bottom	30.1	28.3	23.33	0.17	4.33	0.00	1.50	19.83	0.00	0.00

TR2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*
19-Jul-12	1.3	108.0	bottom	30.1	42.7	3.33	3.33
19-Sep-12	0.5	103.0	bottom	30.3	32.7	1.83	1.83
14-Nov-12	0.5	106.0	bottom	26.1	40.3	4.17	4.17
24-Jan-13	0.7	92.0	bottom	21.1	38.7	12.83	12.83
20-Mar-13	16.5	91.0	bottom	27.3	34.3	1.50	1.50
15-May-13	13.6	95.0	bottom	28.3	36.3	2.00	2.00

TR3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL
19-Jul-12	1.0	106.0	bottom	30.3	54.0	0.00
19-Sep-12	0.7	115.0	bottom	29.8	51.3	0.00
14-Nov-12	1.7	111.0	bottom	24.3	49.7	0.00
24-Jan-13	1.3	99.0	bottom	20.5	29.7	0.00
20-Mar-13	17.7	97.0	bottom	26.2	43.0	0.00
15-May-13	20.2	104.0	bottom	27.9	27.7	0.00

Table SA1 continued.

TR4A DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Bat sp.*	*Ace sp.*
19-Jul-12	1.0	129.0	bottom	30.5	21.3	0.00	0.00	0.00
19-Sep-12	0.7	128.0	bottom	30.0	35.0	0.00	0.00	0.00
14-Nov-12	0.9	101.0	bottom	25.2	31.0	0.00	0.00	0.00
24-Jan-13	1.3	100.0	bottom	21.0	18.7	0.00	0.00	0.00
20-Mar-13	19.1	95.0	bottom	25.6	39.3	0.33	0.33	0.00
15-May-13	23.8	100.0	bottom	28.3	33.7	0.83	0.50	0.67

TR5 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*
19-Jul-12	1.7	92.0	bottom	30.0	105.7	0.00	0.00
19-Sep-12	1.4	88.0	bottom	30.2	101.7	2.00	2.00
14-Nov-12	9.2	86.0	bottom	24.1	96.0	0.00	0.00
24-Jan-13	1.8	67.0	bottom	22.2	104.3	0.00	0.00
20-Mar-13	20.4	75.0	bottom	26.3	103.0	0.00	0.00
15-May-13	26.0	70.0	60.0	28.4	102.3	0.33	0.33

TR6 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*	*Tha tes*	*Ace sp.*	*Sar sp.*	*Pol sp.*
19-Jul-12	4.0	117.0	70.0	30.9	76.7	34.33	0.00	2.00	20.67	12.33	2.17	0.67	0.83
19-Sep-12	3.3	128.0	60.0	30.4	69.7	12.33	0.00	1.50	12.33	0.00	0.00	0.00	0.00
14-Nov-12	12.0	125.0	71.0	24.8	74.7	32.33	0.00	0.33	16.83	15.00	0.00	1.00	0.00
24-Jan-13	13.1	99.0	bottom	21.0	76.3	38.00	0.00	0.67	28.83	10.17	0.00	0.00	0.00
20-Mar-13	21.8	110.0	bottom	25.1	75.7	58.00	0.00	0.33	51.67	7.67	0.00	0.00	0.00
15-May-13	27.0	105.0	64.0	28.1	72.0	63.00	0.17	1.67	46.00	17.17	0.50	0.00	0.00

Table SA2. Summary of SAV surveys conducted at East Creek (EC 1-3) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Utricularia spp., Ruppia maritima, Batophora oerstedii, Najas marina, Chara hornemanii,* and *Halodule wrightii.*

EC1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Rup mar*	*Bat sp.*	*Naj mar*	*Cha hor*
20-Jul-12	0.2	70	Bottom	30.7	82.7	27.67	0.83	22.50	2.33	0.17	6.17
20-Sep-12	0.3	57	Bottom	32.1	76.7	63.17	14.33	34.17	6.17	0.00	17.67
15-Nov-12	0.3	69	Bottom	25.5	63.0	58.00	16.33	23.67	3.17	0.00	21.00
23-Jan-13	0.5	52	Bottom	21.2	68.0	56.67	25.17	30.33	5.33	0.17	15.83
22-Mar-13	12.5	45	Bottom	23.1	76.3	43.00	6.33	24.00	11.17	0.00	8.83
13-May-13	19.2	55	Bottom	31	67.0	16.83	0.33	6.83	3.33	0.00	10.83

Table SA2 continued.

EC2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Cha hor*	*Naj mar*	*Rup mar*	*Utr sp.*
20-Jul-12	0.2	87	Bottom	30.7	37.3	7.33	0.00	0.33	7.00	0.33
20-Sep-12	0.3	80	Bottom	33.2	56.0	8.00	0.00	1.67	6.67	0.00
15-Nov-12	0.3	83	Bottom	25.6	ns	8.67	0.17	2.50	6.17	0.33
23-Jan-13	0.6	70	Bottom	21.1	60.0	5.50	0.00	1.00	5.33	0.00
22-Mar-13	13.3	70	Bottom	24	60.3	5.50	0.00	0.17	5.50	0.00
13-May-13	20.5	75	Bottom	30.7	44.0	7.33	0.00	0.00	7.33	0.00

EC3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Hal wri*
20-Jul-12	0.4	97	Bottom	30.8	60.7	22.67	6.50	16.83
20-Sep-12	0.4	93	Bottom	31.9	54.7	17.33	12.50	5.33
15-Nov-12	0.6	96	Bottom	25.6	63.3	16.33	13.67	2.83
23-Jan-13	1.6	75	Bottom	21.3	57.0	23.33	20.00	4.17
22-Mar-13	15.2	80	Bottom	24.4	57.3	17.00	13.67	3.33
13-May-13	22.4	87	Bottom	31.4	66.0	13.67	10.17	4.17

Table SA3. Summary of SAV surveys conducted at West Joe Bay (WJ 1-2) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Utricularia sp.*, *Chara hornemanii*, *Najas marina*, *Ruppia maritima*, *Batophora oerstedii*, and *Cladophora sp.*

WJ1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*
2-Jul-12	1	64	Bottom	31.8	75.7	54.33	2.00	29.33	4.33	35.67	11.17	0.33
13-Sep-12	0.2	50	Bottom	28.1	70.7	76.67	14.00	63.83	6.67	15.17	8.83	0.00
3-Nov-12	1.1	64	Bottom	24.8	71.0	68.67	10.50	39.83	6.33	15.17	17.50	0.00
16-Jan-13	0.7	37	Bottom	22.5	85.7	83.33	14.33	51.67	4.83	6.67	43.00	0.00
8-Mar-13	13.5	34	Bottom	25.7	78.7	72.00	3.50	15.00	3.33	12.00	48.00	0.00
16-May-13	20.8	43	Bottom	26.7	73.0	28.00	0.00	1.33	0.00	8.17	20.67	1.00

WJ2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Utr sp.*
2-Jul-12	0.9	57	Bottom	32.7	67.0	98.67	94.33	4.50	13.67	16.50	0.00
13-Sep-12	0.2	72	Bottom	29.1	60.7	100.00	99.67	2.50	5.83	23.67	0.00
3-Nov-12	1.0	68	Bottom	25.2	60.0	100.00	99.67	2.17	7.00	44.67	2.00
16-Jan-13	2.2	40	Bottom	24.9	58.3	100.00	100.00	0.33	1.50	48.67	1.50
8-Mar-13	18.1	45	Bottom	24.5	71.3	78.00	61.67	0.00	1.00	50.00	1.00
16-May-13	20.9	35	Bottom	27.5	55.7	71.67	68.00	0.00	0.33	24.17	0.00

Table SA4. Summary of SAV surveys conducted at Joe Bay (JB 1-6) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Utricularia sp.*, *Chara hornemanii*, *Najas marina*, *Ruppia maritima*, *Batophora oerstedii*, *Cladophora sp.*, *Halodule wrightii*, *Acetabularia sp.*, *Sargassum sp.*, *Polysiphonia sp.*, and *Laurencia sp.*

JB1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Naj mar*	*Rup mar*	*Bat sp.*	*Cla sp.*
18-Jul-12	0.3	61.0	bottom	28.5	78.7	18.83	1.33	9.67	2.83	2.33	4.50	1.33
17-Sep-12	0.3	60.0	bottom	28.1	88.0	45.00	33.00	9.00	1.83	4.33	2.83	0.00
31-Oct-12	4.7	88.0	bottom	22.6	56.0	45.33	38.33	5.00	2.17	5.00	1.50	0.00
28-Jan-13	2.0	41.0	bottom	24.9	66.7	21.17	14.33	2.17	1.50	3.00	3.50	0.17
27-Mar-13	18.3	43.0	bottom	17.4	79.7	15.17	0.00	0.00	0.00	2.17	3.83	13.00
14-May-13	21.0	50.0	bottom	28.1	74.3	35.83	0.00	0.00	0.00	8.00	1.33	28.67

JB2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Utr sp.*	*Cha hor*	*Naj mar*	*Bat sp.*	*Cla sp.*
18-Jul-12	0.3	85	bottom	29.4	76.0	56.67	3.83	0.00	47.67	16.33	7.33	0.00
17-Sep-12	0.3	68	bottom	29.2	61.7	73.17	1.67	0.33	66.17	20.50	5.17	0.00
31-Oct-12	5.8	99	bottom	22.5	84.3	46.67	1.83	0.00	44.50	2.17	1.83	0.00
28-Jan-13	7.7	45	bottom	24.8	73.7	40.83	3.17	0.00	37.17	0.83	3.50	0.00
27-Mar-13	17.8	50	bottom	18.6	74.3	41.67	3.33	0.00	38.33	0.00	1.00	0.67
14-May-13	21.9	46	bottom	30	82.7	38.17	2.33	0.00	34.00	0.00	6.17	0.00

JB3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*
18-Jul-12	0.4	76.0	bottom	30.0	69.3	14.00	9.50	0.00	5.67
17-Sep-12	0.3	78.0	bottom	29.5	65.3	16.00	15.17	0.17	1.67
31-Oct-12	11.2	109.0	bottom	23.2	58.7	11.67	10.00	0.00	2.00
28-Jan-13	11.5	65.0	bottom	24.1	61.3	15.00	12.83	0.00	2.50
27-Mar-13	19.1	68.0	bottom	19.1	76.0	8.83	6.33	0.00	4.00
14-May-13	26.6	70.0	bottom	29.3	68.7	9.00	4.83	0.00	5.33

Table SA4 continued.

JB4 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*	*Ace sp.*
18-Jul-12	1.7	140.0	bottom	30.5	9.0	44.67	0.00	13.67	31.50	0.50
17-Sep-12	1.0	132.0	113.0	29.0	6.3	13.50	0.00	9.67	4.83	0.00
31-Oct-12	12.1	162.0	75.0	21.4	3.3	21.17	0.00	4.00	18.00	0.00
28-Jan-13	13.8	114.0	50.0	23.3	4.3	31.00	0.33	2.50	29.33	0.00
27-Mar-13	24.0	116.0	bottom	19.3	ns	29.33	0.00	0.00	29.33	0.00
14-May-13	28.9	126.0	bottom	29.1	6.3	32.33	1.00	2.00	27.00	5.50

JB5 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*	*Sar sp.*	*Pol sp.*
18-Jul-12	1.6	64.0	bottom	31.3	80.0	77.00	0.00	1.33	77.00	0.00	0.00
17-Sep-12	0.7	59.0	bottom	30.2	81.3	29.00	16.33	0.00	14.67	0.00	0.17
31-Oct-12	10.1	98.0	70.0	21.8	78.7	31.33	15.50	0.00	18.50	0.00	0.00
28-Jan-13	26.3	59.0	bottom	24.4	67.3	53.67	20.50	0.00	36.00	0.00	0.00
27-Mar-13	24.8	50.0	bottom	21.0	73.7	51.67	1.50	0.00	51.67	0.00	0.00
14-May-13	29.3	54.0	bottom	29.6	92.0	66.00	3.00	0.00	65.00	1.33	0.00

JB6 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*	*Sar sp.*	*Pol sp.*	*Lau sp.*
18-Jul-12	2.0	72.0	bottom	31.9	75.0	81.00	0.00	0.33	81.00	0.17	0.83	0.67
17-Sep-12	0.6	78.0	bottom	30.7	42.3	53.33	0.17	0.00	52.67	0.83	0.00	0.67
31-Oct-12	12.4	100.0	70.0	22.3	78.0	42.33	1.67	0.00	42.00	0.00	0.00	0.00
28-Jan-13	25.4	44.0	bottom	24.7	87.7	82.33	8.50	0.00	82.33	1.33	0.33	0.00
27-Mar-13	24.2	64.0	bottom	20.6	57.3	60.33	2.17	0.00	60.33	0.00	0.00	0.00
14-May-13	28.3	50.0	bottom	29.5	73.3	74.67	1.33	0.00	74.00	1.33	0.00	0.00

Table SA5. Summary of SAV surveys conducted at Sunday Bay (SB 1-3) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Ruppia maritime, Chara hornemanii, Batophora oerstedii,* and *Halodule wrightii.*

Table SA5 continued.

SB1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Cha hor*	*Bat sp.*
12-Jul-12	0.5	59	Bottom	27.9	53.7	17.83	4.33	11.83	2.67
11-Sep-12	1.7	48	Bottom	33.1	59.3	36.00	14.67	24.33	7.50
16-Nov-12	13.2	62	Bottom	26	49.0	74.00	41.83	22.83	19.50
22-Jan-13	18.8	41	Bottom	23.7	53.8	69.00	31.83	37.67	17.17
31-Mar-13	23.6	41	Bottom	22.8	61.7	56.00	17.67	22.33	19.50
10-May-13	29.3	47	Bottom	29.9	64.7	36.00	6.00	28.83	5.17

SB2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Cha hor*	*Hal wri*	*Rup mar*	*Bat sp.*
12-Jul-12	0.8	85	Bottom	28.4	52.7	13.33	0.33	12.67	0.33	0.00
11-Sep-12	1.7	79	Bottom	30.8	51.7	18.67	0.17	8.00	0.67	11.67
16-Nov-12	14	85	Bottom	26.4	48.7	25.50	0.00	7.67	2.83	18.67
22-Jan-13	21.7	69	Bottom	24.2	51.3	40.83	0.00	12.17	3.33	31.33
31-Mar-13	24.6	63	Bottom	23.9	60.3	26.33	0.00	12.83	13.33	6.00
10-May-13	29.5	80	Bottom	30.3	47.3	30.67	0.00	27.83	4.50	2.67

SB3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Hal wri*	*Bat sp.*
12-Jul-12	4.2	87	Bottom	29.4	32.3	17.33	17.33	0.17
11-Sep-12	1.5	74	Bottom	32.1	42.3	12.83	12.83	0.00
16-Nov-12	14.4	85	Bottom	25.3	36.0	10.50	10.50	0.00
22-Jan-13	19	63	Bottom	24	50.0	14.83	14.83	0.00
31-Mar-13	27.3	61	Bottom	24.8	43.7	7.50	7.50	0.00
10-May-13	30.2	76	Bottom	30.2	31.3	17.67	17.67	0.00

Table SA6. Summary of SAV surveys conducted at Highway Creek (HC 1-6) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Utricularia sp.*, *Chara hornemanii*, *Ruppia maritima*, *Batophora oerstedii*, *Cladophora sp.*, *Spirogyra sp.*, *Nitella sp.*, *Halodule wrightii*, and *Tha tes.*

HC1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Rup mar*	*Bat sp.*	*Cla sp.*
16-Jul-12	0.3	33.0	bottom	28.3	136.0	1.50	1.33	0.00	0.17	0.17	0.00
10-Sep-12	0.5	27.0	bottom	28.6	123.7	0.00	0.00	0.00	0.00	0.00	0.00
2-Nov-12	13.4	54.0	bottom	24.6	169.0	0.00	0.00	0.00	0.00	0.00	0.00
21-Jan-13	10.4	20.0	bottom	23.3	141.3	1.83	0.00	0.17	1.67	0.33	0.17
31-Mar-13	20.9	23.0	bottom	28.8	128.3	0.50	0.00	0.00	0.50	0.33	0.17
8-May-13	18.8	30.0	bottom	25.4	134.7	6.00	0.00	0.00	5.33	0.83	0.00

Table SA6 continued.

HC1A Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Rup mar*	*Bat sp.*	*Cla sp.*	*Spi sp.*
16-Jul-12	0.3	57.0	bottom	28.8	103.0	72.00	3.00	62.17	20.00	1.33	0.00	5.33
10-Sep-12	0.5	51.0	bottom	29.0	109.3	83.33	26.67	71.00	4.50	1.50	0.00	0.00
2-Nov-12	13.9	79.0	bottom	26.0	106.3	63.67	5.00	48.33	10.67	6.17	0.00	0.00
21-Jan-13	11.2	24.0	bottom	23.6	135.3	47.00	0.33	38.50	4.17	6.00	3.67	0.00
31-Mar-13	19.2	46.0	bottom	26.1	102.0	23.67	0.00	3.00	3.00	10.33	14.33	0.00
8-May-13	19.1	53.0	bottom	25.2	102.7	37.83	0.00	22.50	3.50	5.83	11.67	0.00

HC2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Utr sp.*	*Cha hor*	*Rup mar*	*Bat sp.*	*Nit sp.*	*Cla sp.*	*Spi sp.*
16-Jul-12	0.3	60.0	bottom	23.5	99.7	42.67	0.00	42.00	0.50	2.17	0.00	0.00	1.33
10-Sep-12	0.4	68.0	bottom	29.1	88.0	61.67	0.50	60.67	3.50	2.67	0.00	0.00	0.00
2-Nov-12	17.5	90.0	bottom	27.8	96.7	56.67	1.67	47.33	4.67	8.33	4.33	8.67	0.00
21-Jan-13	11.6	55.0	bottom	25.5	97.7	59.33	0.00	38.00	5.83	16.67	0.00	3.17	0.00
31-Mar-13	18.8	59.0	bottom	25.7	96.7	31.00	0.00	3.17	1.50	22.00	0.00	7.00	0.00
8-May-13	21.6	68.0	bottom	26.9	93.0	6.67	0.00	5.00	0.33	1.17	0.00	1.33	0.00

HC3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Cha hor*	*Bat sp.*	*Hal wri*
16-Jul-12	0.3	87.0	bottom	29.6	80.7	2.17	0.00	2.17	0.17	0.00
10-Sep-12	0.4	87.0	bottom	30.8	77.7	9.17	0.17	8.83	0.00	0.67
2-Nov-12	18.1	115.0	bottom	26.5	84.0	21.33	0.00	21.33	0.00	0.00
21-Jan-13	16.9	84.0	bottom	24.8	92.0	15.83	0.00	15.50	1.67	0.00
31-Mar-13	21.6	79.0	bottom	24.7	88.0	6.83	0.00	6.50	1.33	0.00
8-May-13	25.4	95.0	bottom	27.1	77.7	1.33	0.00	1.33	0.00	0.00

HC4A DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Cha hor*	*Bat sp.*
16-Jul-12	0.3	54.0	bottom	30.5	134.7	51.33	11.00	44.00	2.17
10-Sep-12	0.4	48.0	bottom	31.5	132.7	87.67	24.00	79.33	14.17
2-Nov-12	15.9	81.0	bottom	25.5	119.3	84.67	16.50	64.33	33.33
21-Jan-13	20.3	48.0	bottom	25.4	127.7	90.67	5.00	64.33	78.00
31-Mar-13	24.9	45.0	bottom	26.2	131.0	8.67	2.17	5.67	3.50
8-May-13	26.5	53.0	bottom	28.7	106.3	2.83	0.50	2.67	0.50

Table SA6 continued.

HC5 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Rup mar*	*Bat sp.*	*Hal wri*
16-Jul-12	0.4	87.0	bottom	30.0	93.0	25.33	0.00	0.00	25.33
10-Sep-12	0.8	86.0	bottom	31.3	96.3	14.83	8.33	0.00	7.17
2-Nov-12	18.0	115.0	bottom	24.2	100.0	22.83	7.33	0.00	16.33
21-Jan-13	23.8	90.0	bottom	25.6	95.0	17.17	7.00	0.17	12.50
31-Mar-13	30.2	82.0	bottom	25.8	92.7	9.67	1.83	0.00	8.67
8-May-13	28.8	97.0	bottom	27.3	97.0	33.00	0.33	0.00	33.00

HC6 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Bat sp.*	*Hal wri*	*Tha tes*
16-Jul-12	8.2	113.0	bottom	30.5	72.7	92.33	19.00	92.00	0.00
10-Sep-12	5.6	106.0	bottom	31.9	78.7	91.67	20.33	91.33	0.00
2-Nov-12	18.9	137.0	bottom	23.4	72.3	88.33	8.67	87.67	0.00
21-Jan-13	26.9	112.0	bottom	25.3	71.0	42.00	1.00	42.00	0.00
31-Mar-13	30.5	105.0	bottom	24.3	ns	64.33	0.17	61.33	4.33
8-May-13	32.3	120.0	bottom	27.5	74.3	56.00	0.00	56.00	0.00

Table SA7. Summary of SAV surveys conducted at Barnes Sound (BS 1-4) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Chara hornemanii*, *Ruppia maritima*, *Batophora oerstedii*, *Halodule wrightii*, *Polysiphonia sp.*, *Thalassia testudinum*, *Acetabularia sp.*, *Laurencia sp.*, *Sargassum sp.*, *Penicillus sp.*, *Halimeda sp.*, and *Udotea sp.*

BS1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Cha hor*	*Rup mar*	*Bat sp.*	*Hal wri*	*Pol sp.*
17-Jul-12	0.6	47.0	bottom	28.5	154.0	93.67	1.67	31.67	6.83	78.67	0.00
5-Sep-12	0.9	40.0	bottom	31.5	131.3	96.67	17.17	35.67	4.17	62.33	0.00
30-Oct-12	25.8	83.0	bottom	20.0	132.7	82.00	30.67	44.33	17.00	10.00	0.00
4-Jan-13	17.6	32.0	bottom	25.6	128.7	76.00	45.00	38.50	9.67	1.17	0.00
4-Mar-13	33.2	34.0	bottom	20.4	136.3	87.33	43.00	47.50	8.17	2.50	4.00
17-May-13	29.5	40.0	bottom	30.6	128.0	85.33	43.00	25.00	33.83	1.83	6.50

Table SA7 continued.

BS2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Bat sp.*	*Hal wri*	*Tha tes*	*Ace sp.*	*Pol sp.*
17-Jul-12	7.8	64.0	bottom	31.8	127.3	46.33	2.17	34.83	14.17	0.00	0.00
5-Sep-12	1.2	42.0	bottom	32.1	120.0	41.67	3.50	20.67	25.17	0.00	0.00
30-Oct-12	26.3	94.0	bottom	20.4	122.7	52.33	19.67	29.67	17.67	0.00	0.00
4-Jan-13	18.4	27.0	bottom	28.6	138.3	41.00	12.67	29.00	12.67	0.50	2.67
4-Mar-13	32.8	55.0	bottom	20.5	131.0	53.00	5.17	43.67	15.67	1.50	2.67
17-May-13	31.0	42.0	bottom	33.3	121.0	71.00	4.67	37.67	43.33	0.50	1.00

BS3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Bat sp.*	*Hal wri*	*Tha tes*	*Lau sp.*	*Ace sp.*	*Pol sp.*	*Sar sp.*
17-Jul-12	17.7	80.0	bottom	32.1	93.7	88.67	0.33	18.17	78.67	1.67	0.17	12.67	0.00
5-Sep-12	2.8	65.0	bottom	32.4	119.0	96.33	0.33	7.17	92.33	0.00	0.00	0.00	0.33
30-Oct-12	27.0	113.0	bottom	20.8	113.0	93.67	0.00	7.67	90.33	0.00	0.00	3.50	0.00
4-Jan-13	21.3	51.0	bottom	27.8	106.3	91.67	0.17	16.17	82.00	0.00	0.00	7.17	0.00
4-Mar-13	31.9	75.0	bottom	19.2	110.3	95.67	0.83	4.33	65.67	0.00	0.00	40.00	0.00
17-May-13	31.6	60.0	bottom	30.9	97.3	99.67	0.00	5.50	78.00	5.83	0.00	33.00	0.00

BS4 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Bat sp.*	*Hal wri*	*Tha tes*	*Lau sp.*	*Pen sp.*	*Ace sp.*	*Hali sp.*	*Pol sp.*	*Udo sp.*
17-Jul-12	17.4	122.0	bottom	31.2	57.7	70.67	1.50	4.83	41.67	19.00	2.00	0.00	1.67	22.67	0.00
5-Sep-12	9.4	118.0	bottom	31.3	69.7	49.67	0.67	1.50	41.00	9.83	1.00	0.00	1.17	0.83	0.00
30-Oct-12	27.3	182.0	bottom	21.6	55.0	46.67	1.67	11.67	35.50	0.00	2.00	0.00	1.00	3.00	0.17
4-Jan-13	27.5	102.0	bottom	26.4	60.7	53.33	2.17	1.17	37.17	15.67	1.83	1.00	1.17	1.33	0.00
4-Mar-13	32.1	127.0	bottom	18.8	65.3	74.67	3.67	0.00	55.33	15.50	7.33	1.00	4.67	0.00	0.00
17-May-13	31.1	105.0	bottom	30.2	71.3	73.00	6.83	1.50	53.33	22.67	2.17	0.83	2.17	0.00	0.00

Table SA8. Summary of SAV surveys conducted at Manatee Bay (MB 1-3) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Tables below are as follows: *Halodule wrightii, Thalassia testudinum, Batophora oerstedii, Polysiphonia sp., Chara hornemanii, Acetabularia sp., Penicillus sp., Laurencia sp., and Sargassum sp.*

MB1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	Total	*Hal wri*	*Tha tes*	*Bat sp.*	*Pol sp.*	*Cha hor*	*Ace sp.*
9-Jul-12	7.0	58.0	Bottom	28.2	103.3	2.50	2.50	0.00	0.83	0.00	0.00	0.00
4-Sep-12	2.0	60.0	Bottom	29.8	108.0	4.67	2.83	0.00	0.67	0.00	2.83	0.00
29-Oct-12	21.8	102.0	Bottom	22.0	119.7	2.50	2.50	0.17	0.83	0.00	0.67	0.00
11-Jan-13	22.6	51.0	Bottom	22.1	113.7	3.67	3.67	0.00	0.17	0.00	0.00	0.00
5-Mar-13	29.5	54.0	Bottom	18.9	105.0	4.83	4.83	0.00	0.00	0.00	0.00	0.00
20-May-13	30.4	54.0	Bottom	27.8	112.7	4.67	4.67	0.00	1.00	0.50	0.00	0.17

Table SA8 continued.

MB2 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	Total	*Hal wri*	*Bat sp.*	*Pol sp.*
9-Jul-12	10.3	63.0	Bottom	28.5	116.0	26.33	26.33	0.00	0.00
4-Sep-12	7.4	63.0	Bottom	30.7	123.3	27.67	27.67	0.00	0.00
29-Oct-12	23.0	120.0	Bottom	22.6	116.3	29.33	29.33	0.00	0.00
11-Jan-13	24.3	59.0	Bottom	23.1	116.7	24.33	24.33	0.00	0.00
5-Mar-13	29.9	60.0	Bottom	19.0	122.3	23.33	23.33	0.00	0.00
20-May-13	32.8	64.0	Bottom	27.7	109.7	17.33	17.33	1.17	0.33

MB3 DATE	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Tha tes*	*Hal wri*	*Pen sp.*	*Ace sp.*	*Lau sp.*	*Pol sp.*	*Bat sp.*	*Sar sp.*
9-Jul-12	15.4	84.0	Bottom	29.9	90.0	93.67	93.33	5.00	0.83	0.00	8.50	0.00	0.00	1.33
4-Sep-12	12.1	93.0	Bottom	30.0	89.3	97.00	95.33	9.67	0.50	0.00	16.17	0.00	0.17	0.00
29-Oct-12	23.2	116.0	Bottom	23.0	ns	91.67	91.33	12.17	0.00	0.00	0.00	0.00	0.33	0.00
11-Jan-13	25.6	94.0	Bottom	23.4	87.0	97.67	88.67	8.00	0.17	0.00	1.00	16.33	3.00	0.00
5-Mar-13	30.4	90.0	Bottom	19.1	84.3	99.33	69.00	3.50	0.00	0.50	1.33	37.00	3.83	0.00
20-May-13	33.0	87.0	Bottom	28.0	89.7	100.00	76.67	2.00	0.17	2.83	20.67	51.67	10.67	0.50

Table SA9. Summary of SAV surveys conducted at Card Sound (CS 1) for report period (2012-13). All totals and individual species values are reported in percent coverage. Values are reported as the mean, calculated from twelve quadrats surveyed per visit. Abbreviated species in the Table below are as follows: *Halodule wrightii, Batophora oerstedii*, and *Polysiphonia sp., Acetabularia sp.,* and *Ruppia maritime.*

CS1 Date	Salinity	Water Depth (cm)	Secchi Depth (cm)	Water Temp (°C)	Sediment Depth (cm)	TOTAL	*Hal wri*	*Bat sp.*	*Pol sp.*	*Ace sp.*	*Rup mar*
17-Jul-12	16.0	76.0	Bottom	31.5	99.3	1.50	0.00	0.50	1.00	0.00	0.00
5-Sep-12	13.5	82.0	Bottom	32.0	100.0	0.00	0.00	0.00	0.00	0.00	0.00
10-Nov-12	26.1	116.0	Bottom	20.4	91.0	0.33	0.00	0.33	0.00	0.00	0.00
9-Jan-13	29.1	81.0	Bottom	25.5	91.7	0.67	0.17	0.67	0.00	0.17	0.00
3-Mar-13	34.1	84.0	Bottom	18.9	93.7	1.17	0.00	1.17	0.00	0.00	0.00
17-May-13	37.2	71.0	Bottom	24.7	102.3	2.17	0.50	2.17	0.00	0.00	0.17

II. Total SAV % Cover for each site surveyed during Report Year.

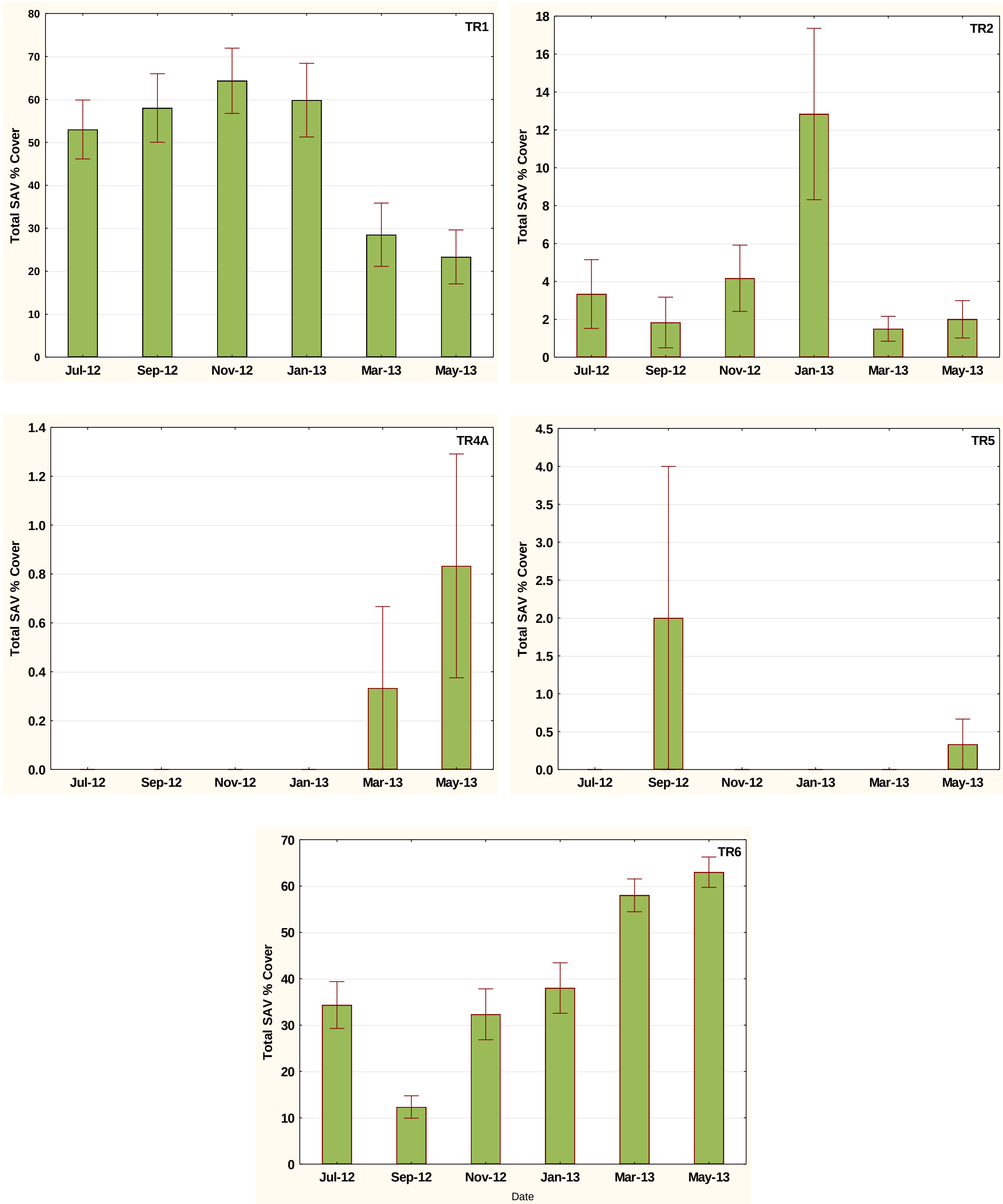


Figure SA1. Mean (±) SE Total SAV percent coverage for the report period (2012-2013) by survey month for the TR1-TR6 sub-sites. None of the graphs are on the same scale. TR3 is not included because the total SAV % cover was 0.0 for all quadrats throughout the report period.

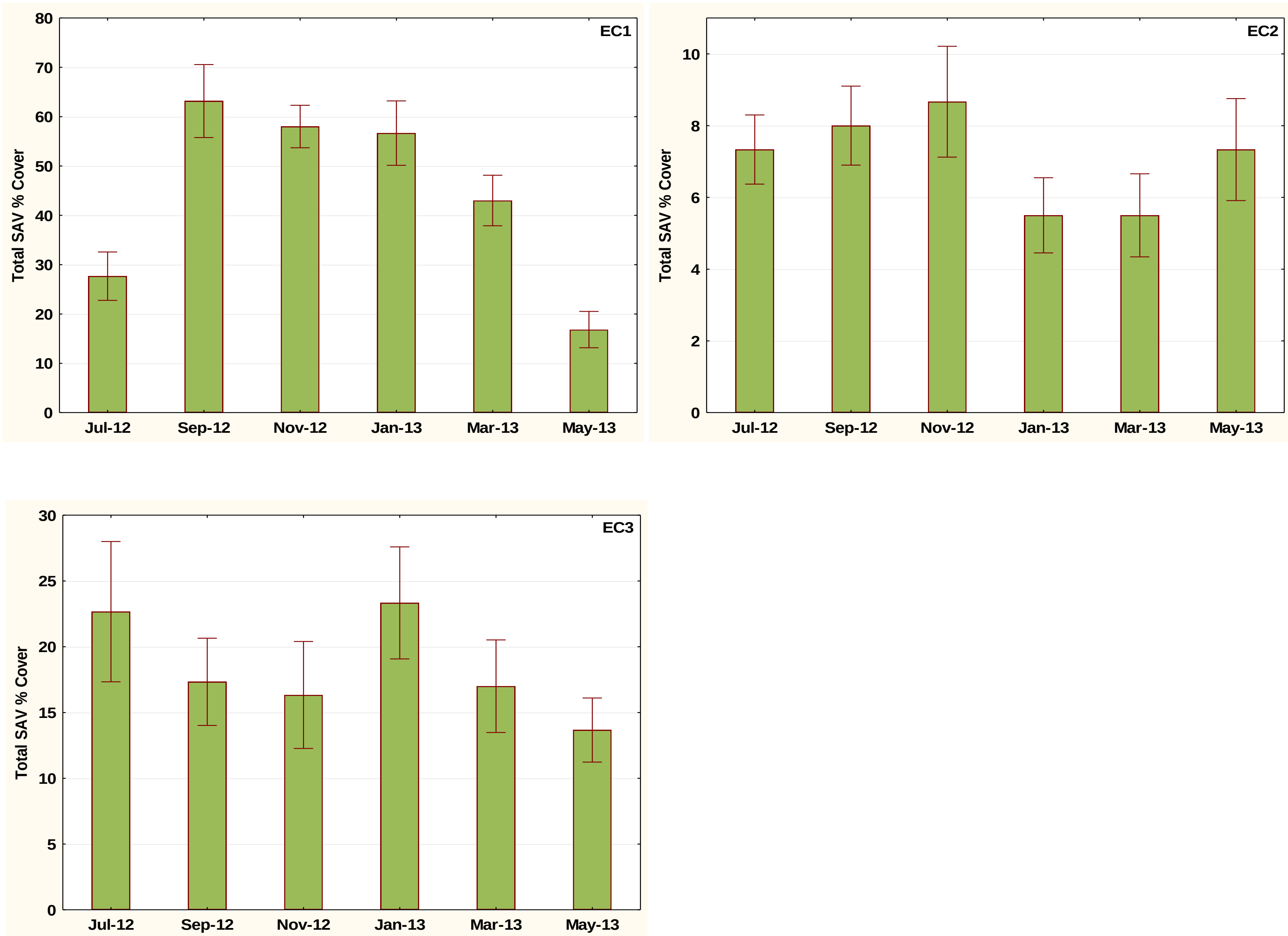
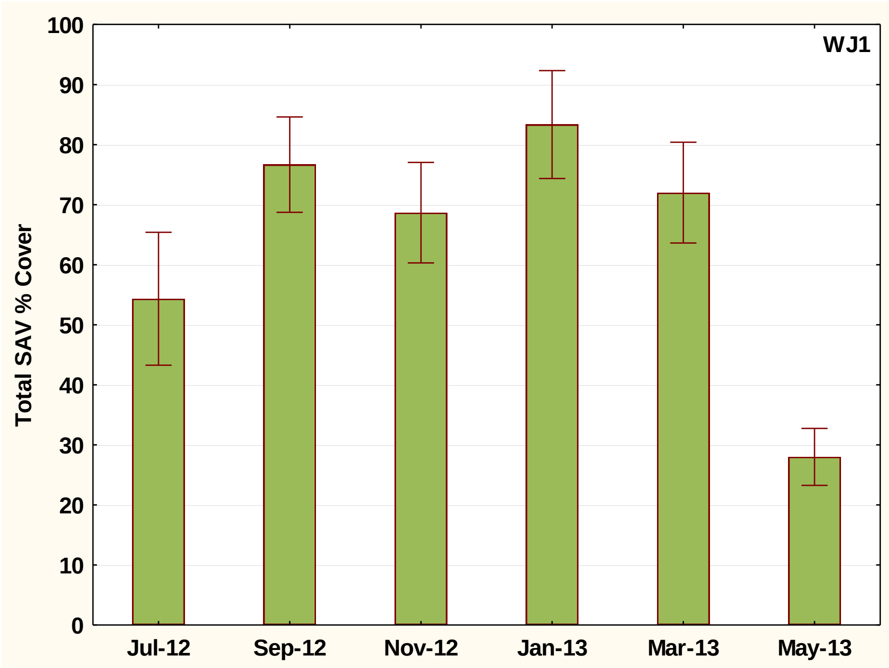


Figure SA2. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the EC1-EC3 sub-sites. All graphs are on a different scale.



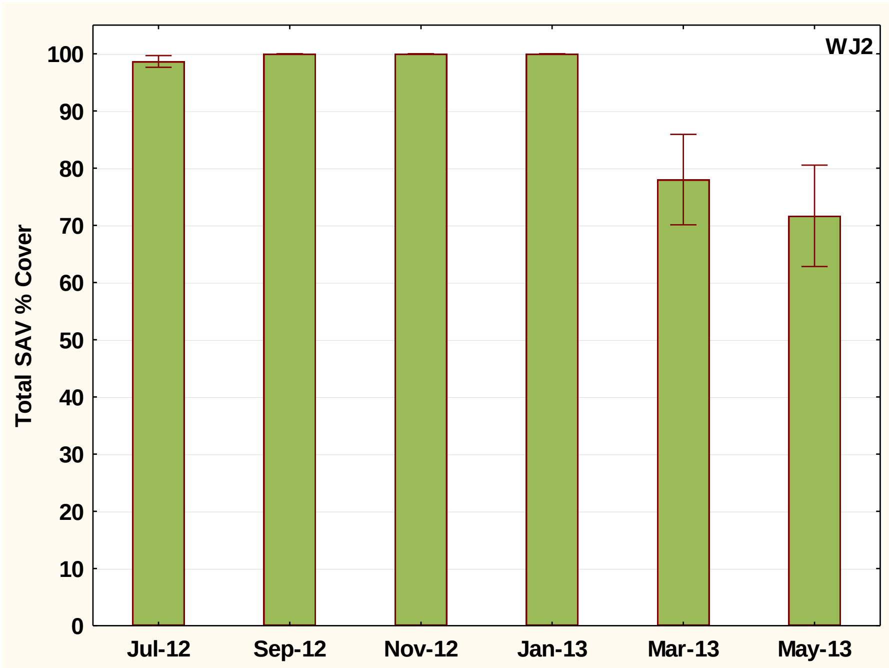


Figure SA3. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the WJ1 and WJ2 sub-sites.

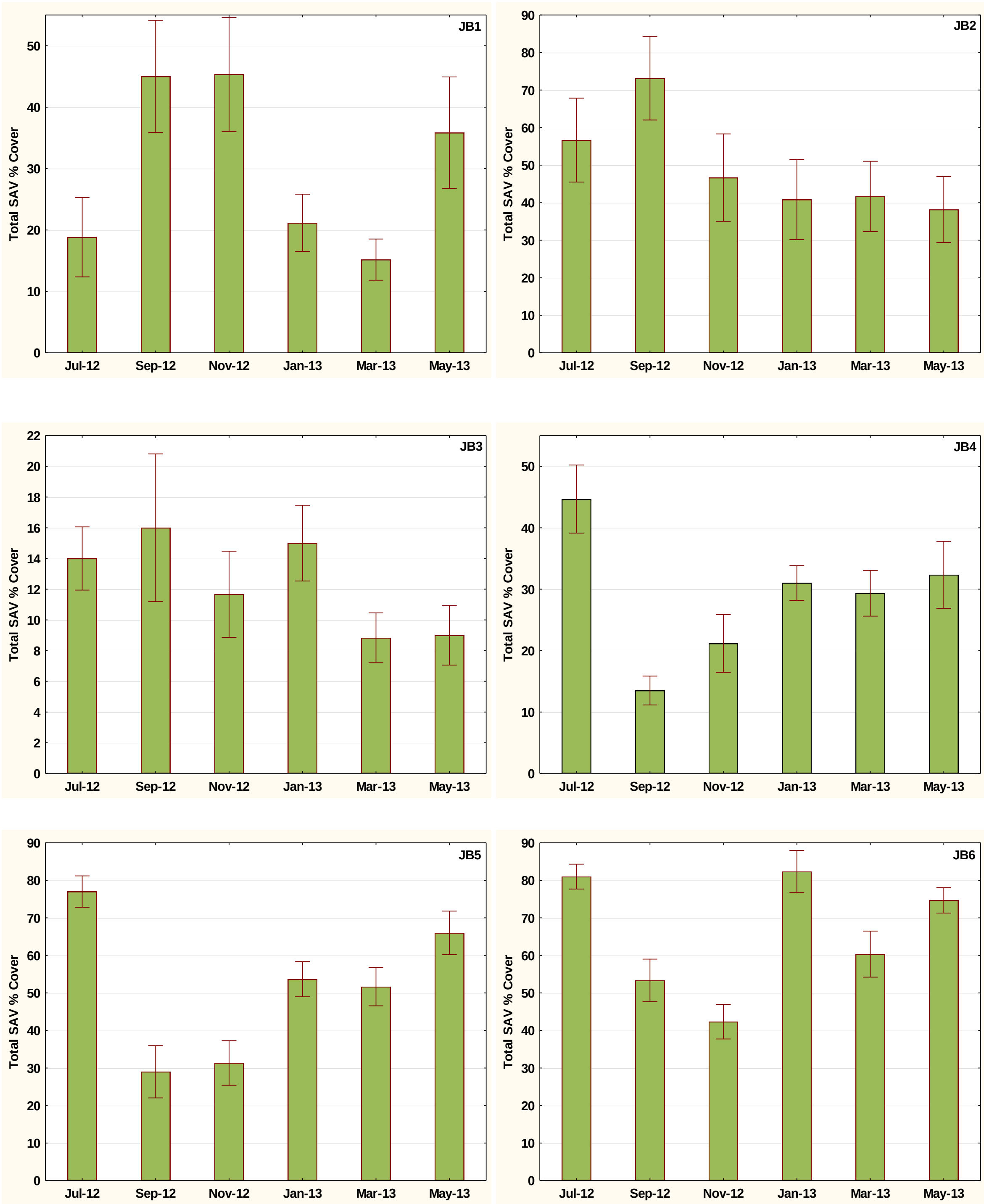


Figure SA4. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the JB1-JB6 sub-sites. Graphs for JB1 and JB4 are on the same scale and graphs of JB2, JB5, and JB6 are on the same scale.

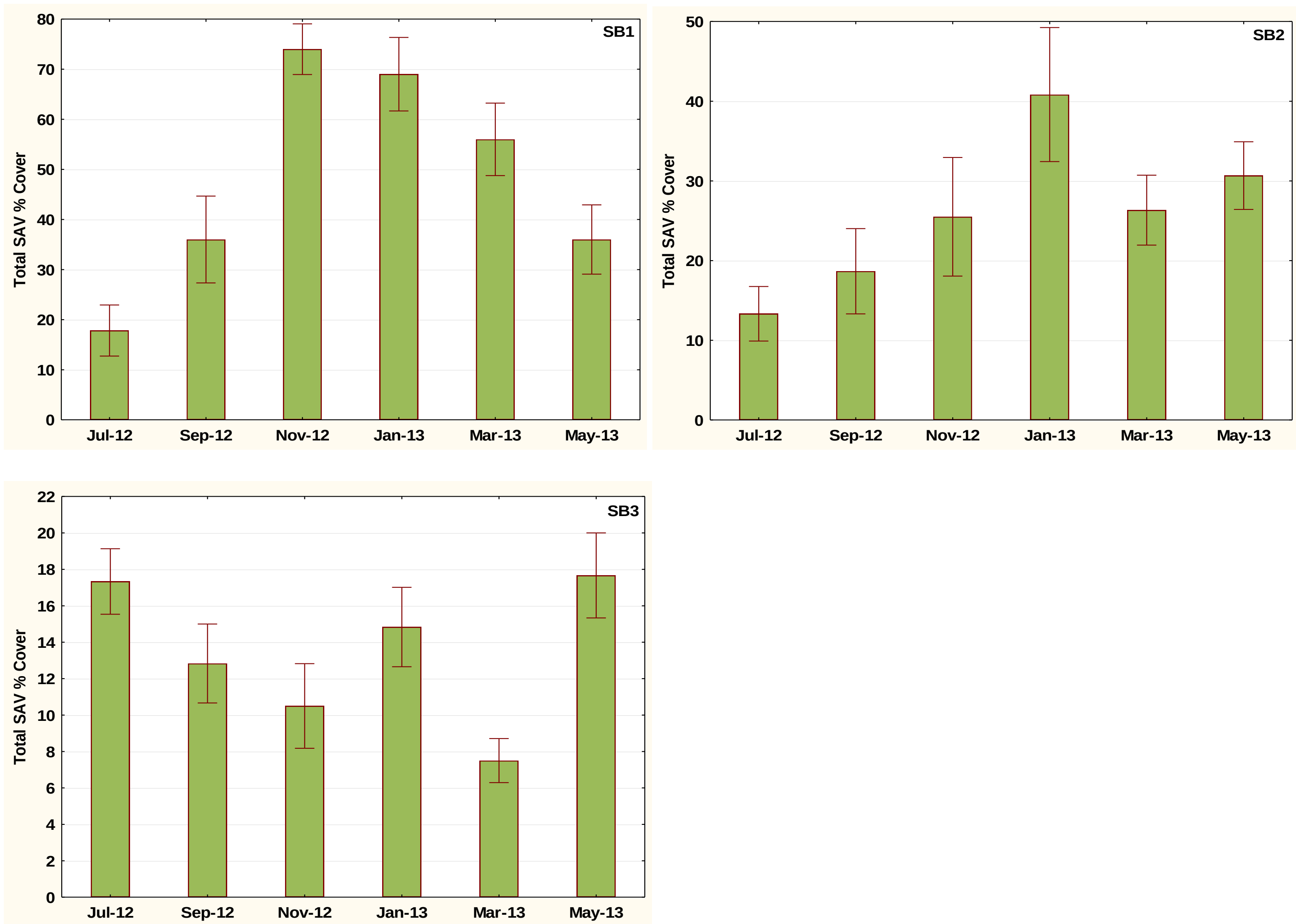


Figure SA5. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the SB1-SB3 sub-sites. All graphs are on a different scale.

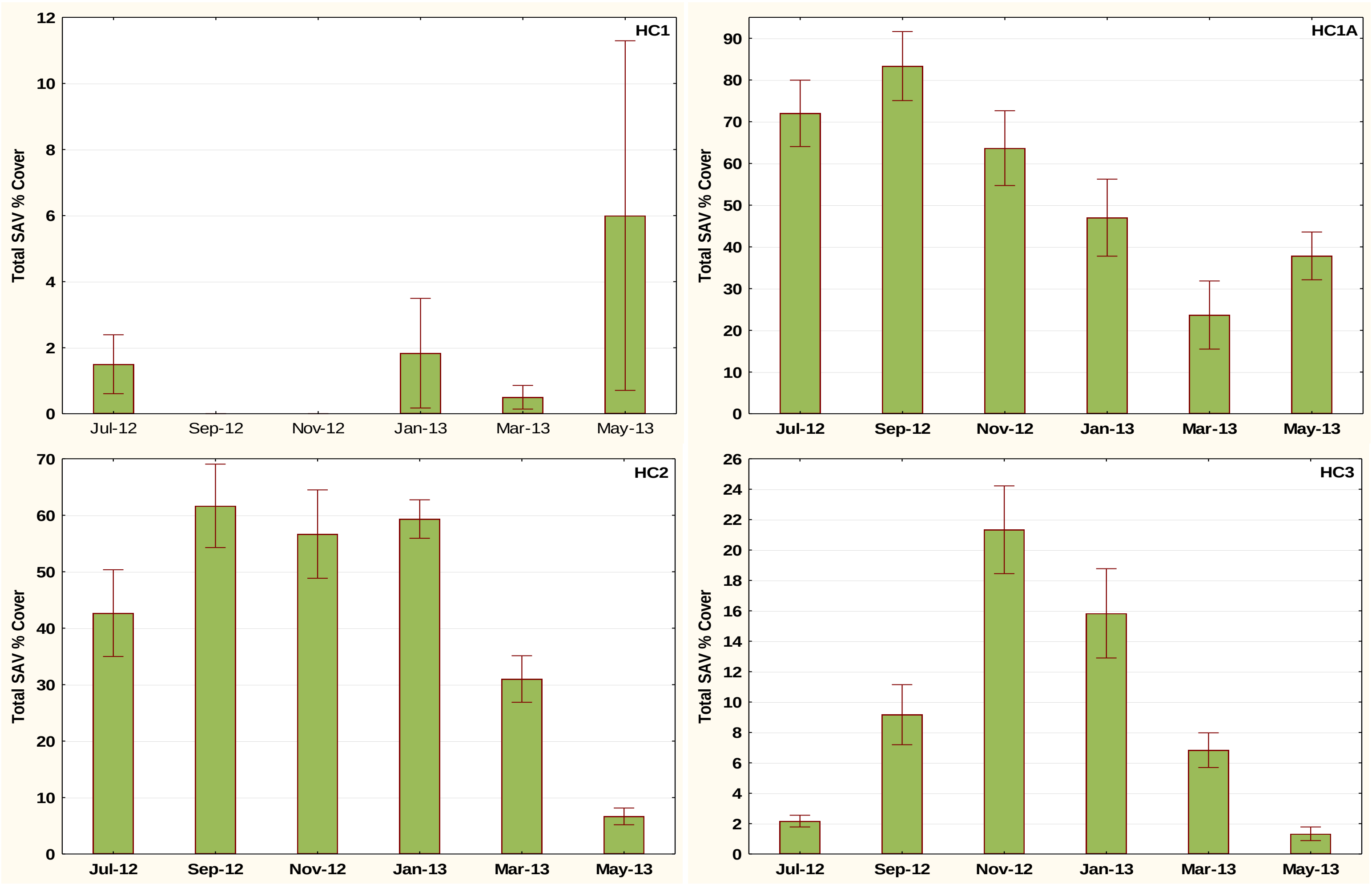


Figure SA6. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the HC1-HC6 sub-sites. With the exception of the HC1A, HC4A and HC6 graphs, all graphs are on a different scale.

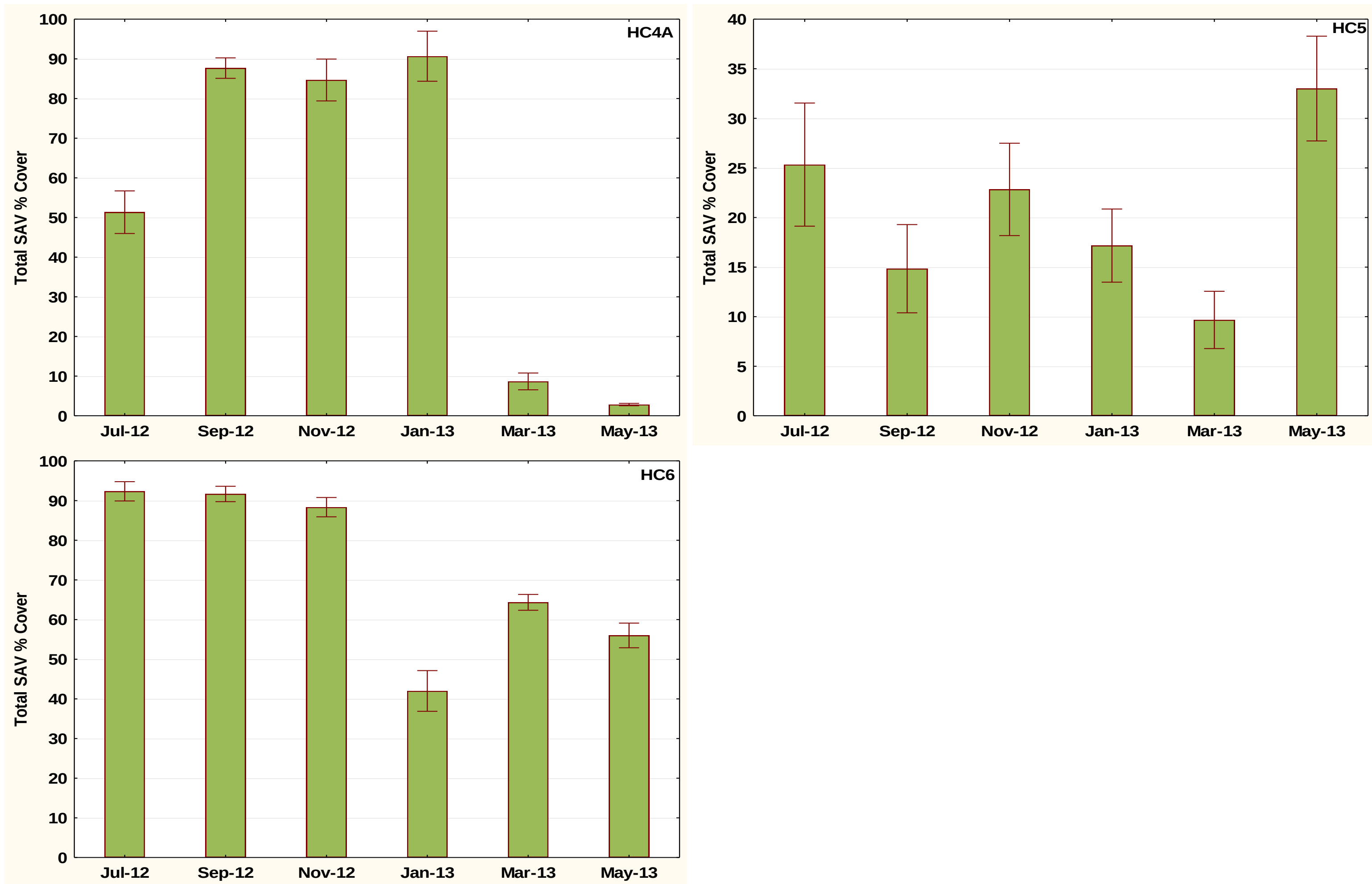


Figure SA6 continued. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the HC1-HC6 sub-sites. With the exception of the HC1A, HC4A and HC6 graphs, all graphs are on a different scale.

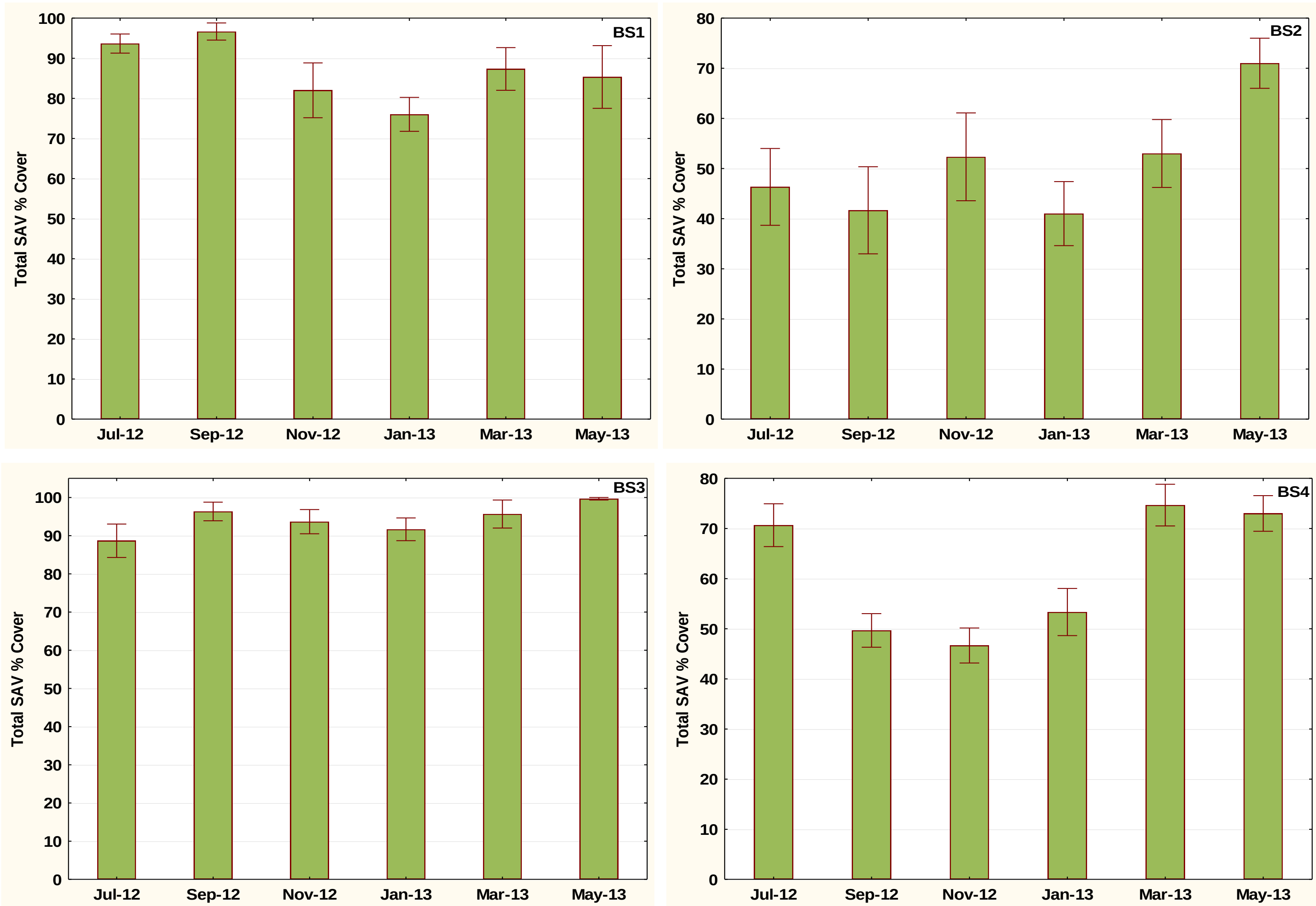


Figure SA7. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the BS1-BS4 sub-sites. The BS1 and BS3 graphs are on the same scale and the BS2 and BS4 graphs are on the same scale.

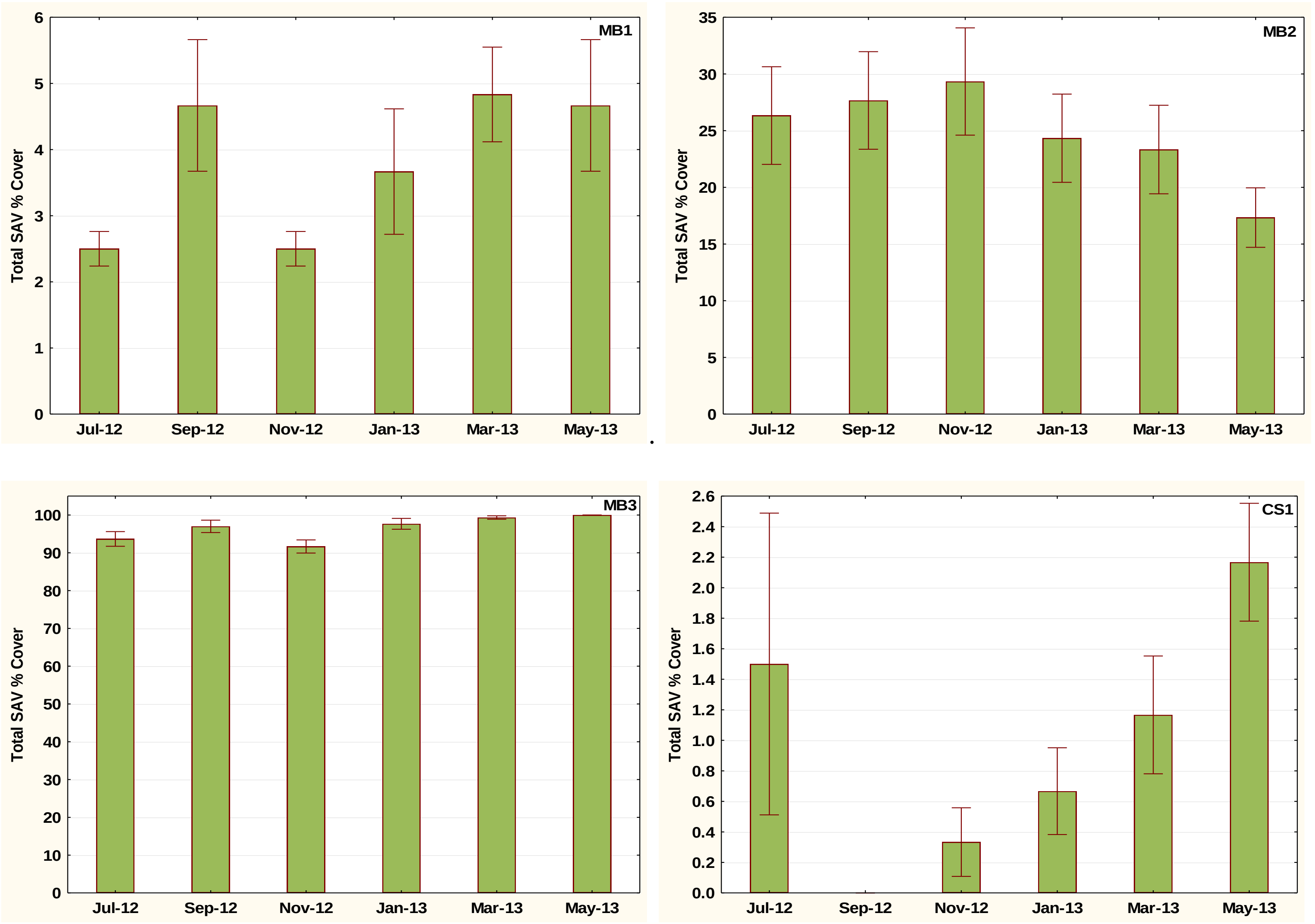


Figure SA8. Mean (±) SE Total SAV percent coverage for the report period (2012-13) by survey month for the MB1-MB3 and CS1 sub-sites. All graphs are on a different scale.

Emergent Vegetation Appendix

I. Summary of emergent vegetation surveys for TR, JB, and HC (Tables EA1-EA3)
II. Number of Stems, Ratio of shoots to stems, and canopy height of emergent vegetation for TR, JB, and HC (Figures EA1 – EA3)

Table EA1. Summary of emergent vegetation surveys conducted at Taylor River Site 1 (TR1) for the report period (2012-13). Counts of shoots and stems are reported as the mean, calculated from six fixed quadrats surveyed per visit. The ratio of shoots to stems was calculated as the ratio of the mean number of stems divided by the mean number of shoots reported for each survey visit. Average and maximum canopy height is the average for quadrats surveyed and was measured using a meter stick marked in 1 cm increments. Emergent vegetation within quadrats, for all sites, consisted only of *Eleocharis spp.*

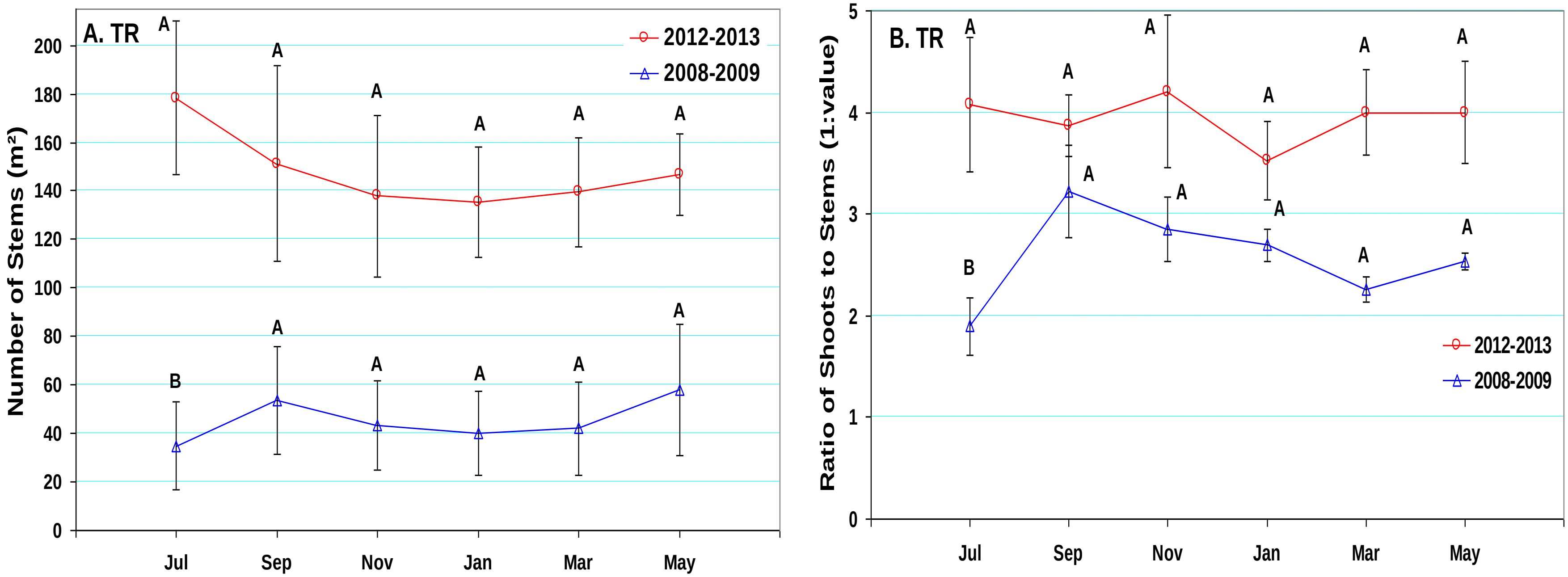
Date	Number of Shoots (m^2)	Number of Stems (m^2)	Ratio of Shoots to Stems	Average Canopy Height (cm)	Maximum Canopy Height (cm)
19-Jul-12	46.8	178.4	1:3.8	56.2	76.6
19-Sep-12	38.8	151.2	1:3.9	59.4	67.6
14-Nov-12	34.0	138.0	1:4.1	53.0	69.0
24-Jan-13	39.6	135.2	1:3.4	45.8	62.2
20-Mar-13	36.4	139.6	1:3.8	41.6	55.0
15-May-13	38.4	146.8	1:3.8	41.8	52.0

Table EA2. Summary of emergent vegetation surveys conducted at Joe Bay Site 1 (JB1) for the report period (2012-13). Counts of shoots and stems are reported as the mean, calculated from six fixed quadrats surveyed per visit. The ratio of shoots to stems was calculated as the ratio of the mean number of stems divided by the mean number of shoots reported for each survey visit. Average and maximum canopy height is the average for quadrats surveyed and was measured using a meter stick marked in 1 cm increments. Emergent vegetation within quadrats, for all sites, consisted only of *Eleocharis spp.*

Date	Number of Shoots (m^2)	Number of Stems (m^2)	Ratio of Shoots to Stems	Average Canopy Height (cm)	Maximum Canopy Height (cm)
18-Jul-12	65.2	191.6	1:2.9	40.6	69.6
17-Sep-12	48.0	186.0	1:3.9	46.8	59.4
31-Oct-12	42.0	164.8	1:3.9	54.0	61.0
28-Jan-13	53.2	184.4	1:3.5	35.4	58.4
27-Mar-13	47.2	161.6	1:3.4	32.8	47.2
14-May-13	36.8	144.8	1:3.9	29.6	39.2

Table EA3. Summary of emergent vegetation surveys conducted at Highway Creek Site 1 (HC1) for the report period (2012-13). Counts of shoots and stems are reported as the mean, calculated from six fixed quadrats surveyed per visit. The ratio of shoots to stems was calculated as the ratio of the mean number of stems divided by the mean number of shoots reported for each survey visit. Average and maximum canopy height is the average for quadrats surveyed and was measured using a meter stick marked in 1 cm increments. Emergent vegetation within quadrats, for all sites, consisted only of *Eleocharis spp.*

Date	Number of Shoots (m^2)	Number of Stems (m^2)	Ratio of Shoots to Stems	Average Canopy Height (cm)	Maximum Canopy Height (cm)
16-Jul-12	9.2	25.6	1:2.8	20.6	33.0
10-Sep-12	10.4	24.0	1:2.3	20.0	27.2
2-Nov-12	6.8	23.6	1:3.5	24.2	29.2
21-Jan-13	10.0	40.0	1:4.0	12.4	31.6
31-Mar-13	12.0	37.6	1:3.1	16.2	26.4
8-May-13	14.8	40.4	1:2.7	20.6	28.4



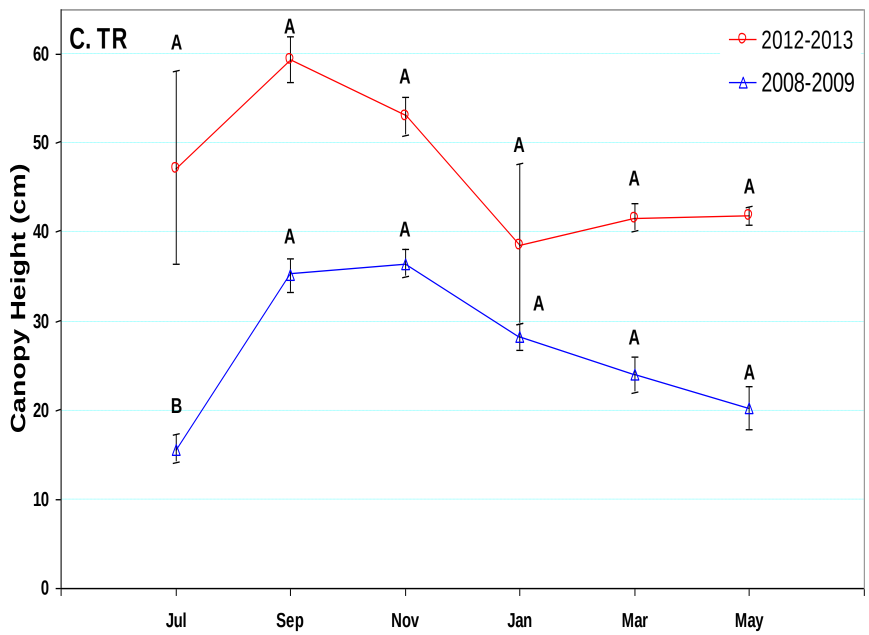
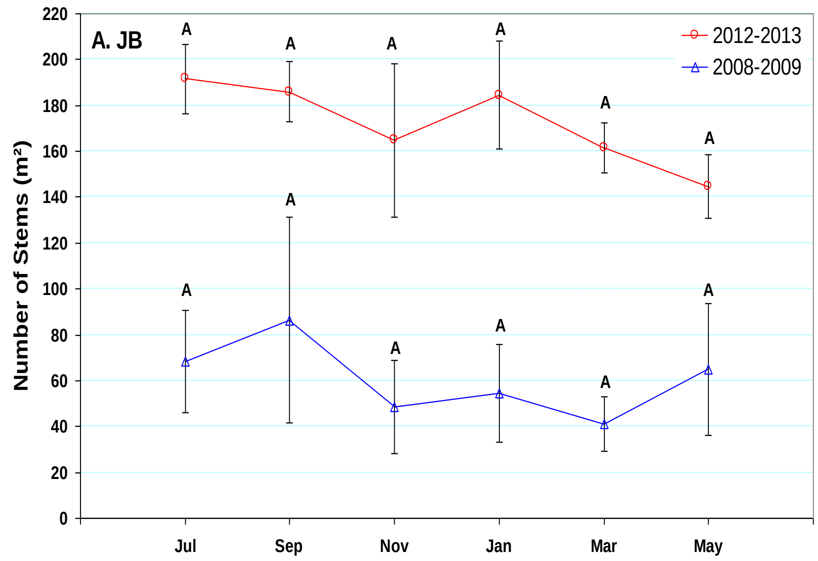
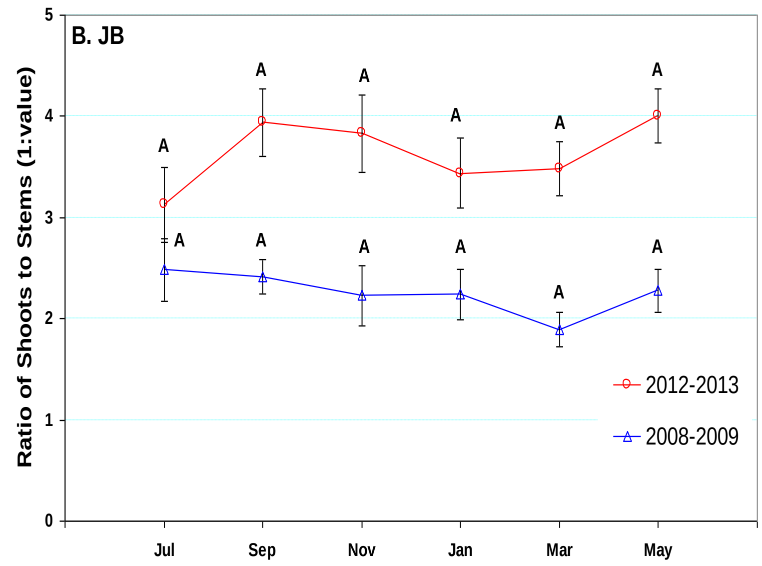


Figure EA1. Comparison of emergent vegetation (A) number of stems (m^2), (B) ratio of shoots to stems, and (C) canopy height at the TR1 site between 2012-13 and 2008-09.





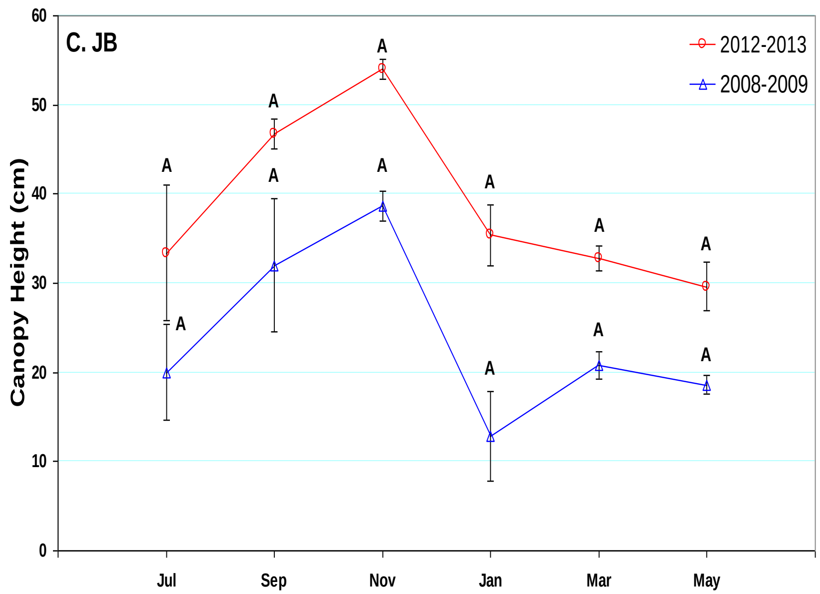
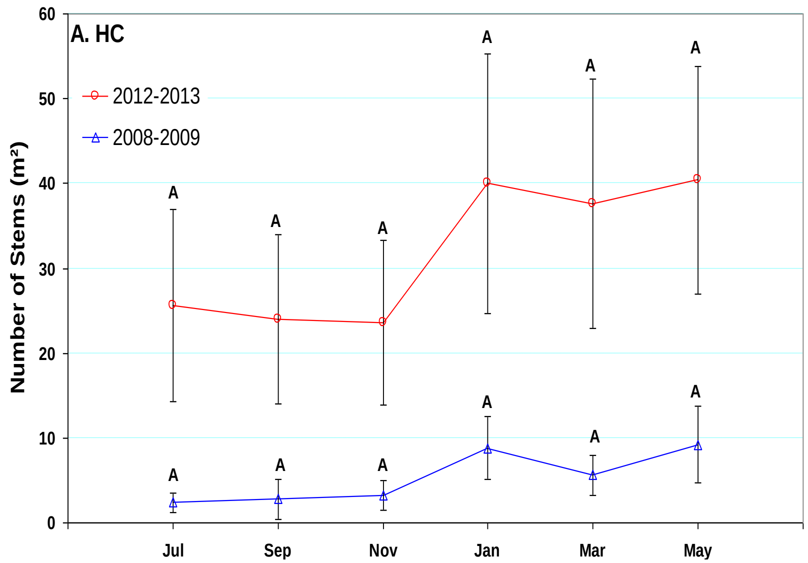
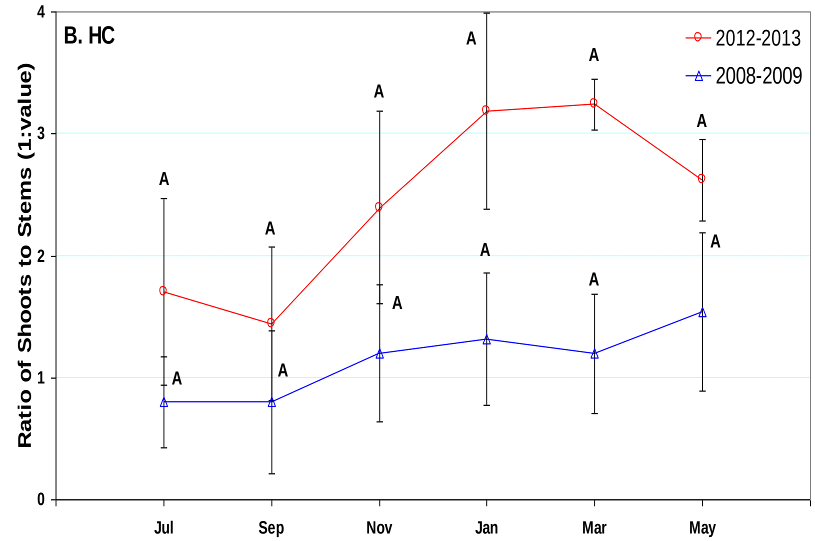


Figure EA2. Comparison of emergent vegetation (A) number of stems (m^2), (B) ratio of shoots to stems, and (C) canopy height at the JB1 site between 2012-13 and 2008-09.





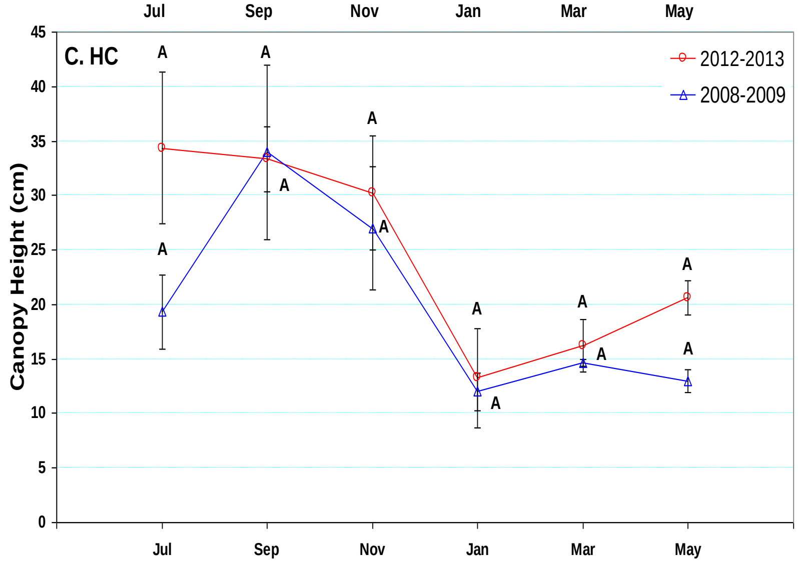


Figure EA3. Comparison of emergent vegetation (A) number of stems (m^2), (B) ratio of shoots to stems, and (C) canopy height at the HC1 site between 2012-13 and 2008-09.